Metal Finishing

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DECEMBER, 1961

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BLISTER-FREE PLATING ON COMPLEX PARTS

Alumon "D" quickly penetrates blind holes, screw threads, grooves, other areas difficult to plate using ordinary zincate baths. Adhesion is excellent; solution rinses freely; and carry-over into plating baths is minimized. Parts shown are plated aluminum components of the U.S. Army Hawk missile weapons system produced by Raytheon's Aero-Weapons Division.

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Automated pre-plate* processing YOU CAN USE

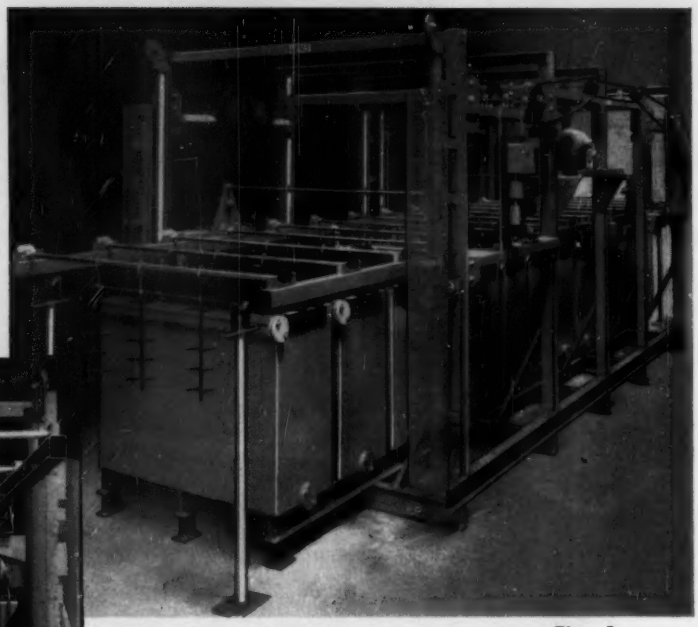

Fig. 1

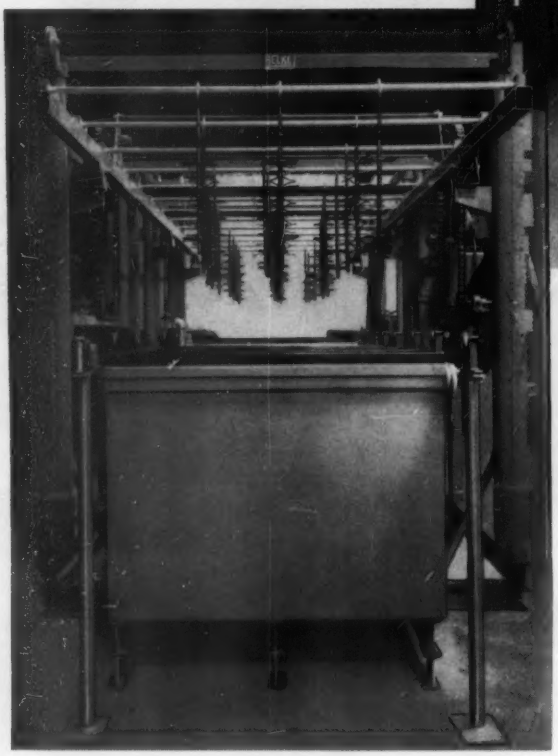

Fig. 2

Fig. 1. View of Automatic Processing Machine from unloading end showing a rod loaded with plating racks about to be deposited in the unloading stand. The racks are put on the rods on loading stands at the other end of the processing machine. The machine picks them up from the stands and transfers them from tank to tank at precisely timed intervals. Figure 2 shows the machine with the racks in the elevated position during the transfering operation.

Typical pre-plate cycles with the Automatic Processing Unit

Removal of carbon smuts, oxide smuts, buffing and drawing compounds, grease and oil from: 1) steel, 2) malleable and grey iron castings, 3) brass, bronze and copper, 4) brass, bronze, copper and steel in the same cycle, 5) die castings, 6) electrolytic descaling of iron and steel, 7) preparing aluminum for anodizing, chromating, painting.

*BELKE Automatic Processing Units are also used for pre-painting and other treatments that require dipping, soaking, electrocleaning, etc. Send requirement details for recommendations.

Enables you to meet variations full automatics can't handle and to produce more per man hour with much less investment.

Tremendous labor savings are achieved through use of BELKE Automatic Pre-plate Processing Units — especially in plants handling varied plating work.

These machines automatically take racked work from loading stands—automatically time and transfer the work through any desired pre-plate cycle such as electric cleaning, anodic electroclean, all sorts of baths and rinses—deposit the processed racks of work on unloading stands.

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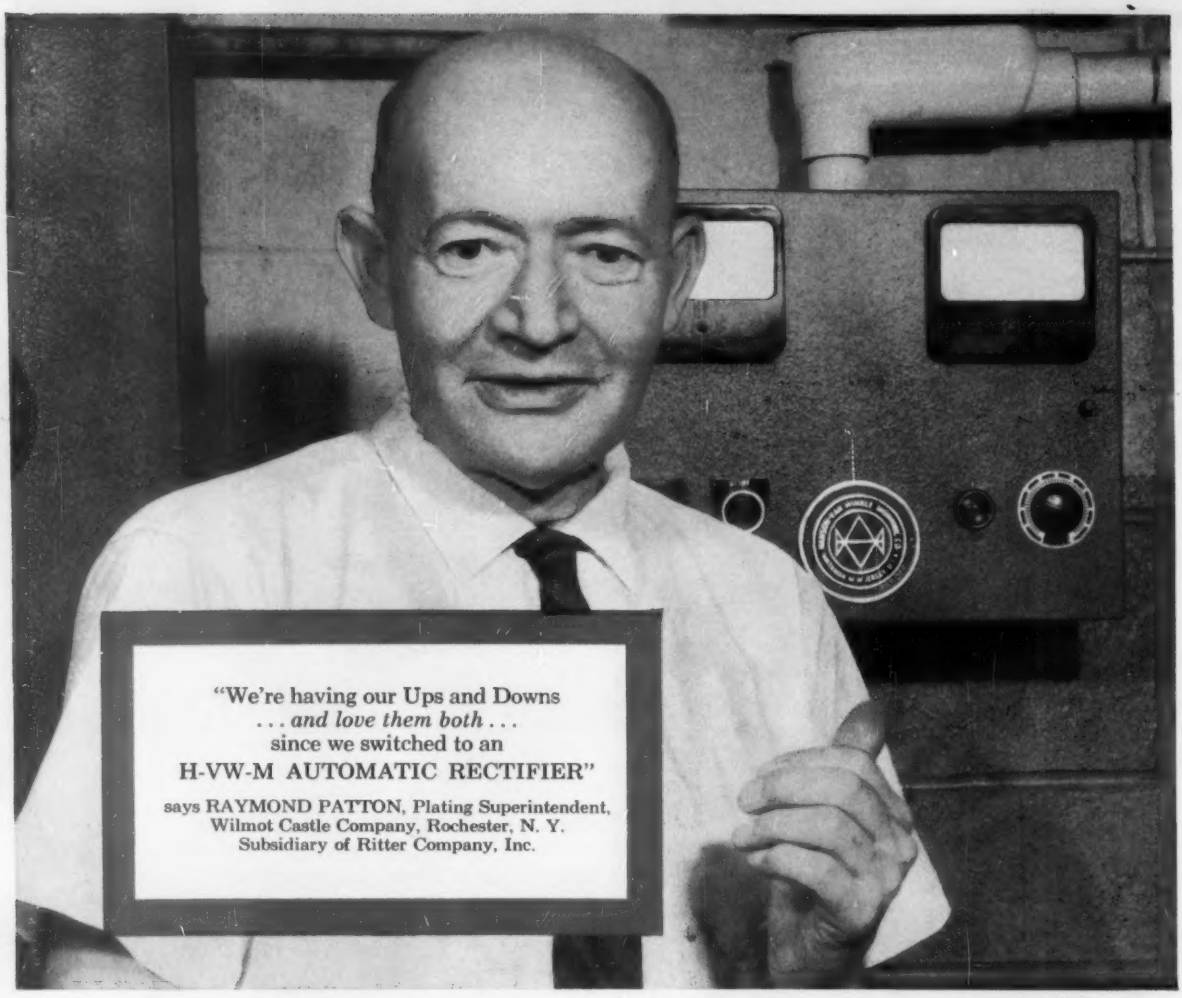
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since we switched to an
H-VW-M AUTOMATIC RECTIFIER"
says RAYMOND PATTON, Plating Superintendent,
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UP 5% goes production . . .
DOWN 25-30% go dial manipulations

Requirements for current vary widely in the chrome-plating operations of Wilmot Castle Company, one of the largest makers of sterilizers, lamps, and other hospital, dental, surgical equipment.

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But now . . . with the new Automatic Rectifier from H-VW-M . . . dial setting remains the same. Current is adjusted automatically for changes in load. With human error removed, rejects are down 5%. Plate is more uniform—for while the old method provided 44 steps of control, with Automatic Voltage Stabilization, control is stepless, virtually infinite.

Says Ray Patton, Wilmot Castle's plating superintendent: "We're gradually retiring all our rectifiers of the tap-switch type—and putting in H-VW-M units that practically think for themselves. We've found that what they seem to think about the most is ways to up our production, cut our costs down."

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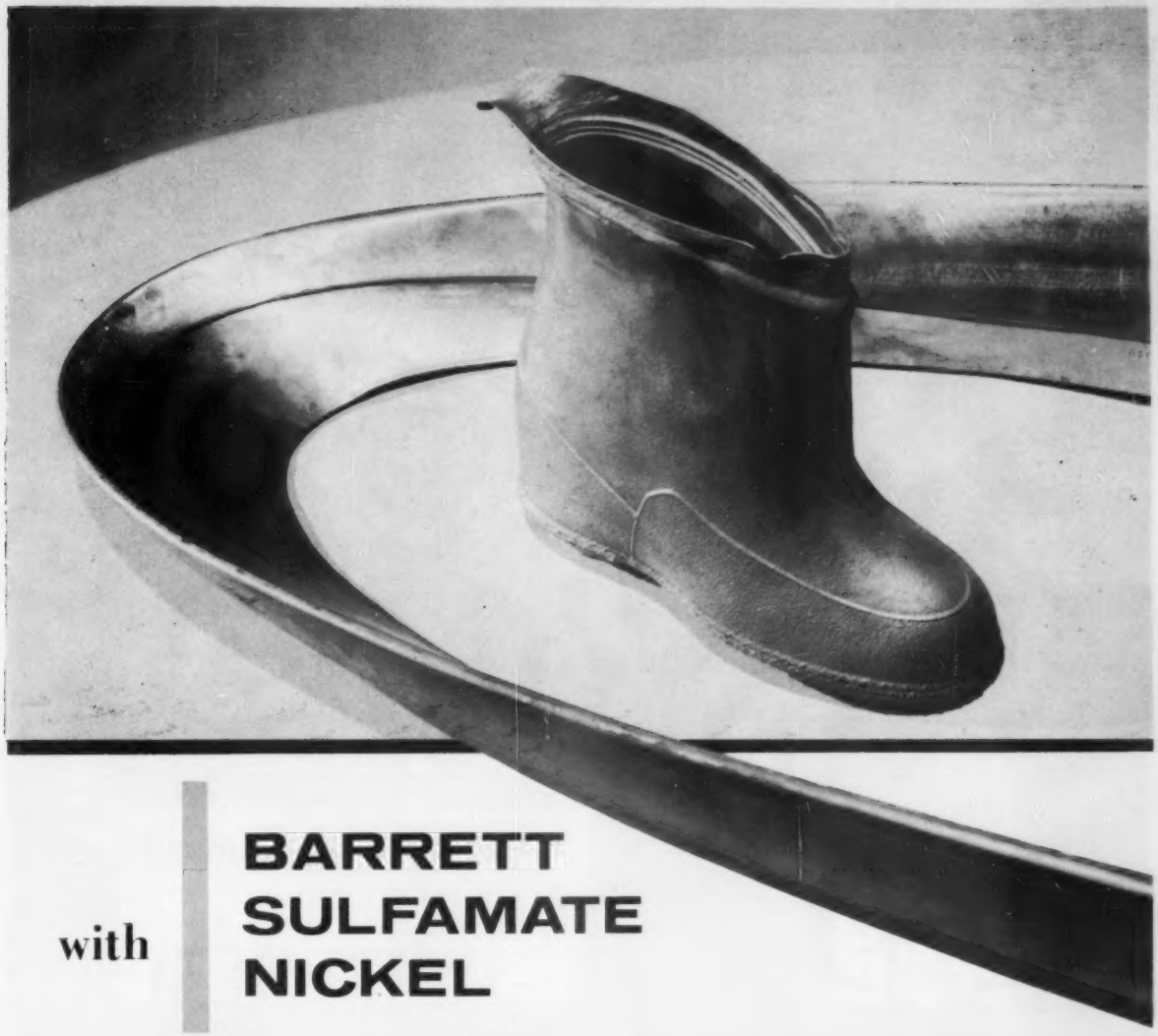

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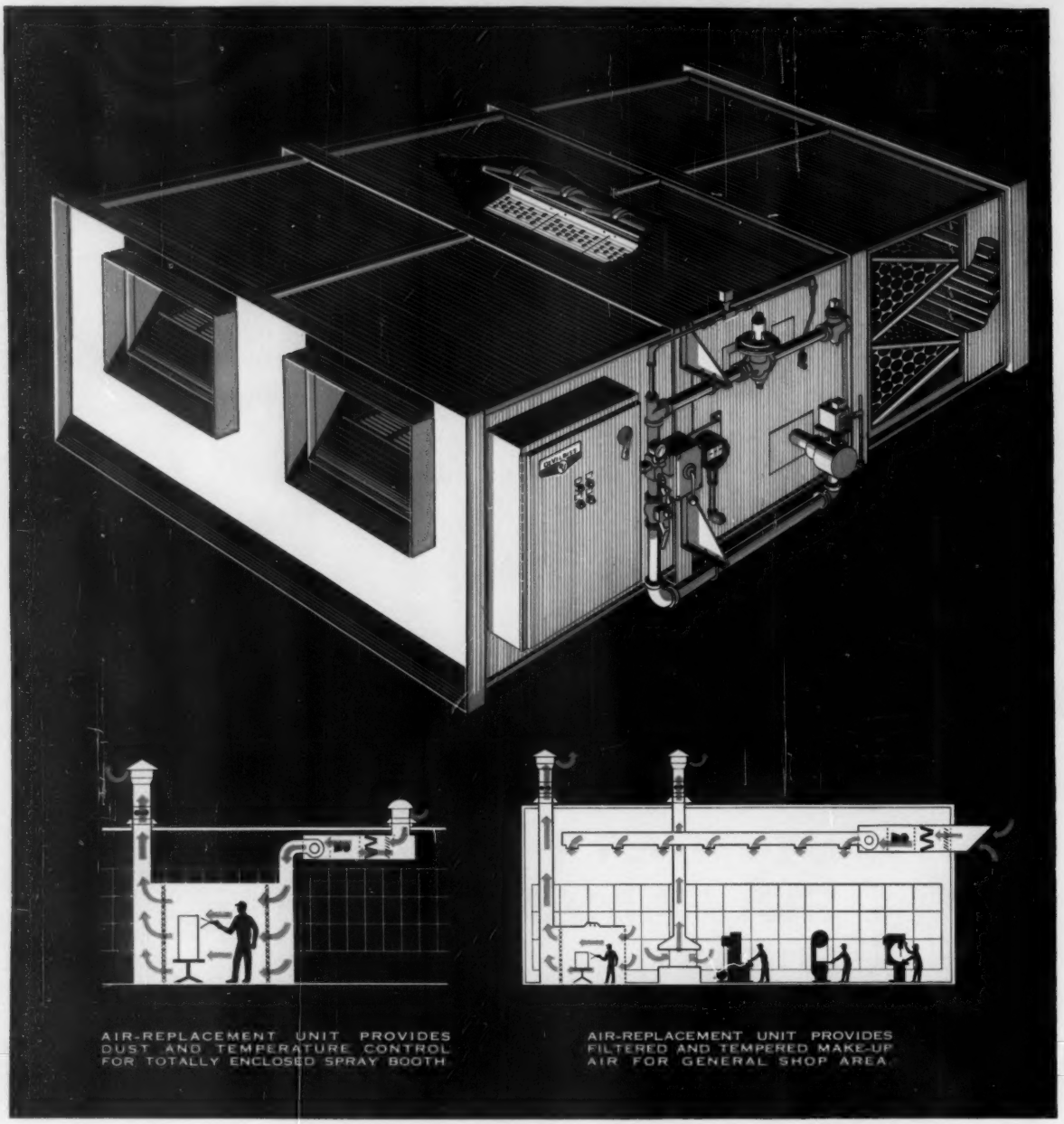
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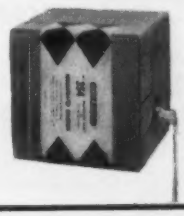
STABILITY—Isobrite 354 has exceptional high temperature stability . . . and it bounces right back to full effectiveness even after long, weekend shutdowns.

Call your Allied Field Engineer for complete information on Isobrite 354 or other Isobrite brighteners for zinc, cadmium and copper. He's listed in the Yellow Pages under "Plating Supplies". Or, write direct for technical data. On the West Coast, write or call the L. H. Butcher Co., licensee.

New Isobrite Pak with Flex-Spout gives pouring, storing and handling ease



Unscrew the cap and pop out the spout for non-drip pouring and accurate measuring. Pop the spout back in for safe, convenient handling. Spout, polyethylene container all packaged in a square, lightweight cardboard container to make storing and inventory easy.

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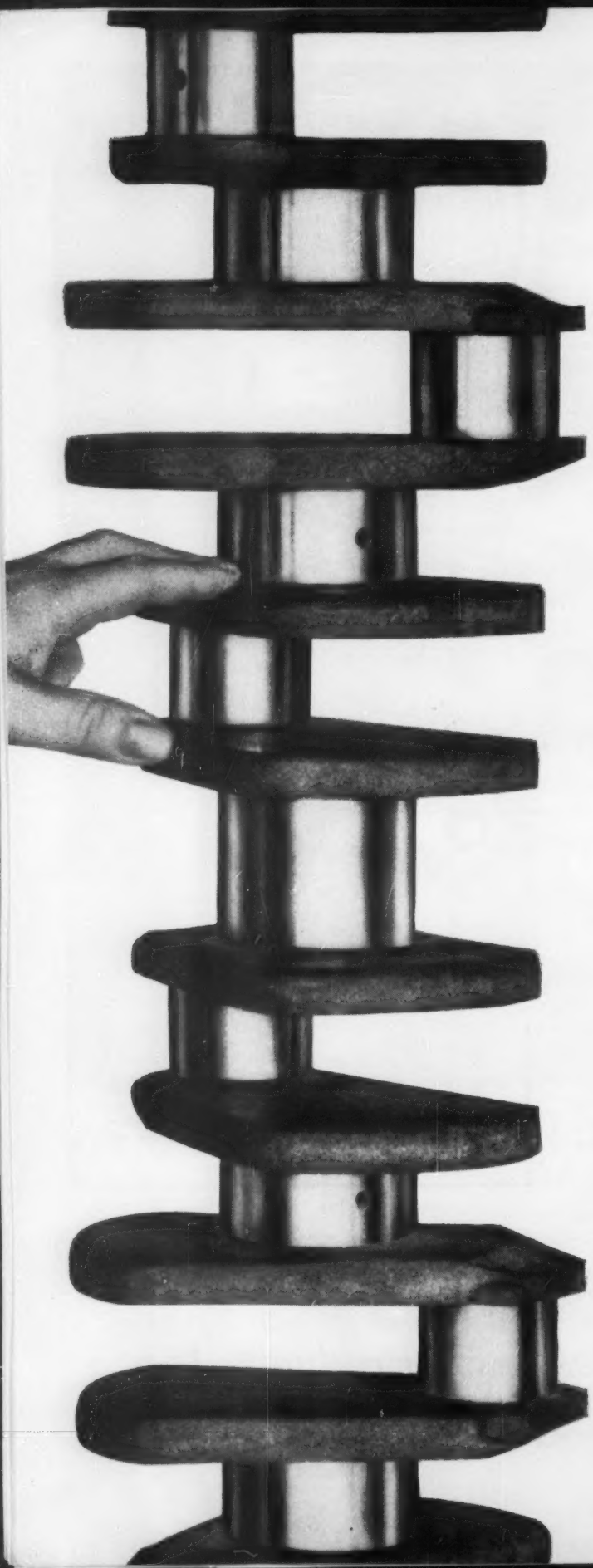

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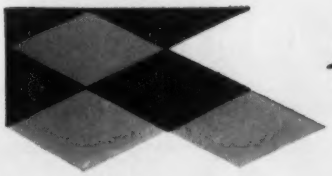

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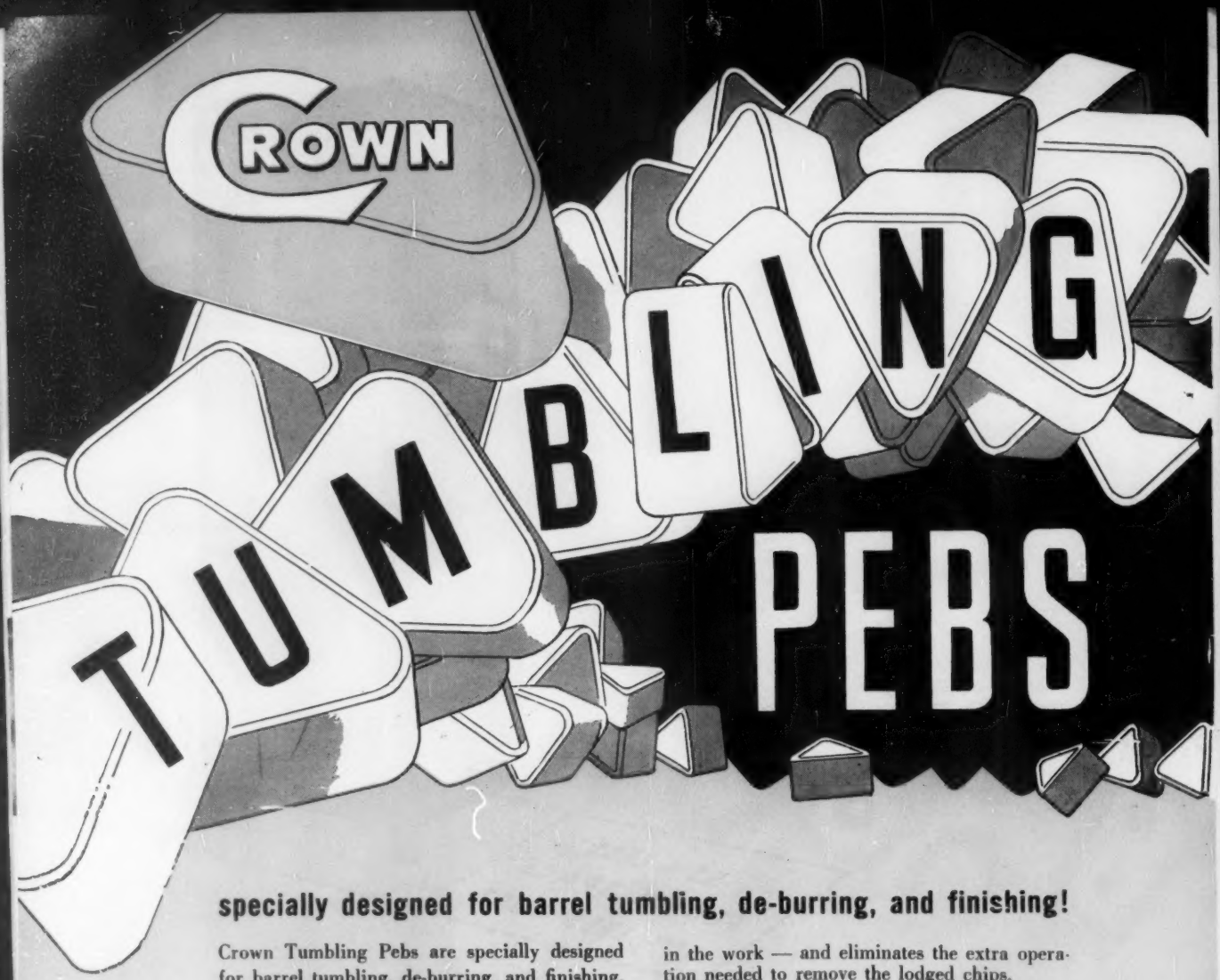

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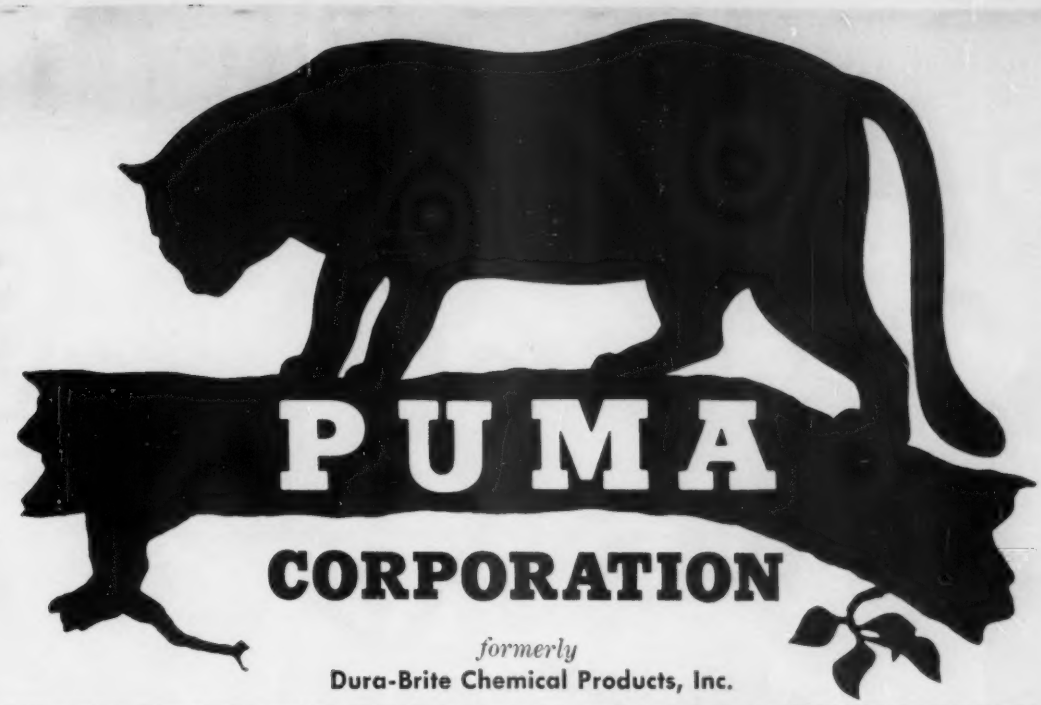

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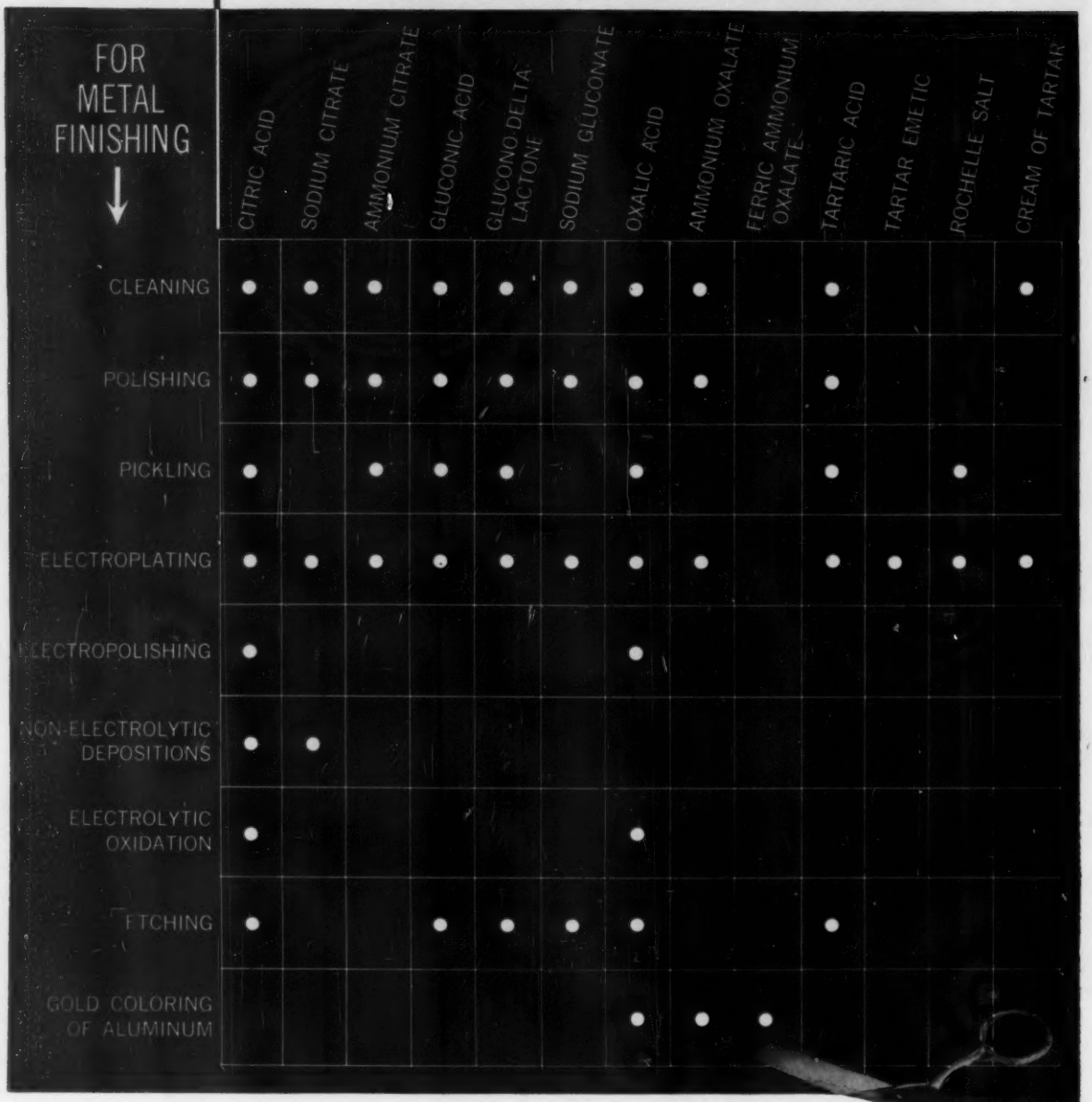

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BRIGHT, HARD, SMOOTH FINISHES

on rough, dull, unbuffed surfaces

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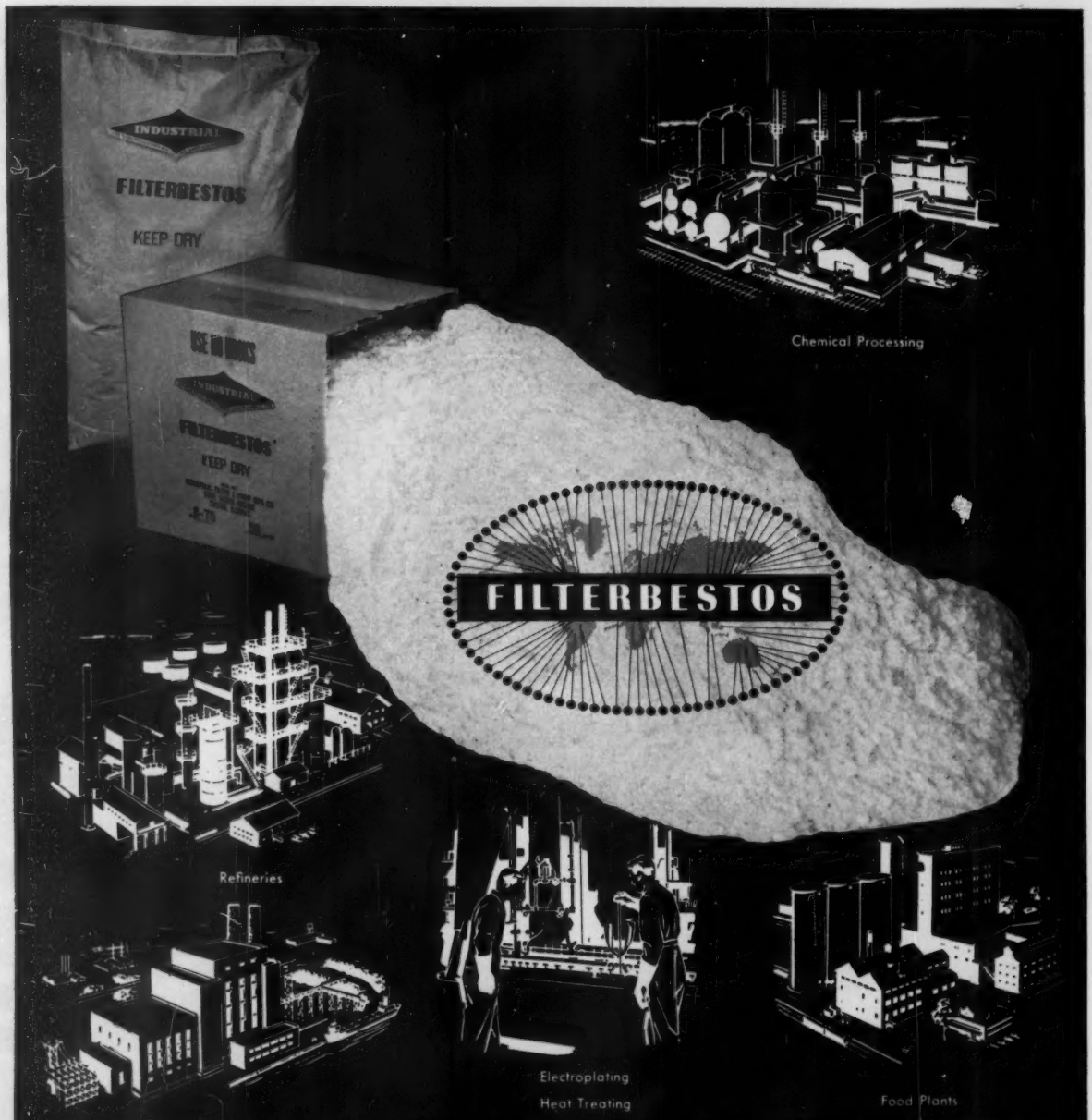
For complete working details, write on your company letterhead for Bulletin 191, Levelmax operating manual. Write Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, N. Y., or call your nearest Federated sales office.

ASARCO



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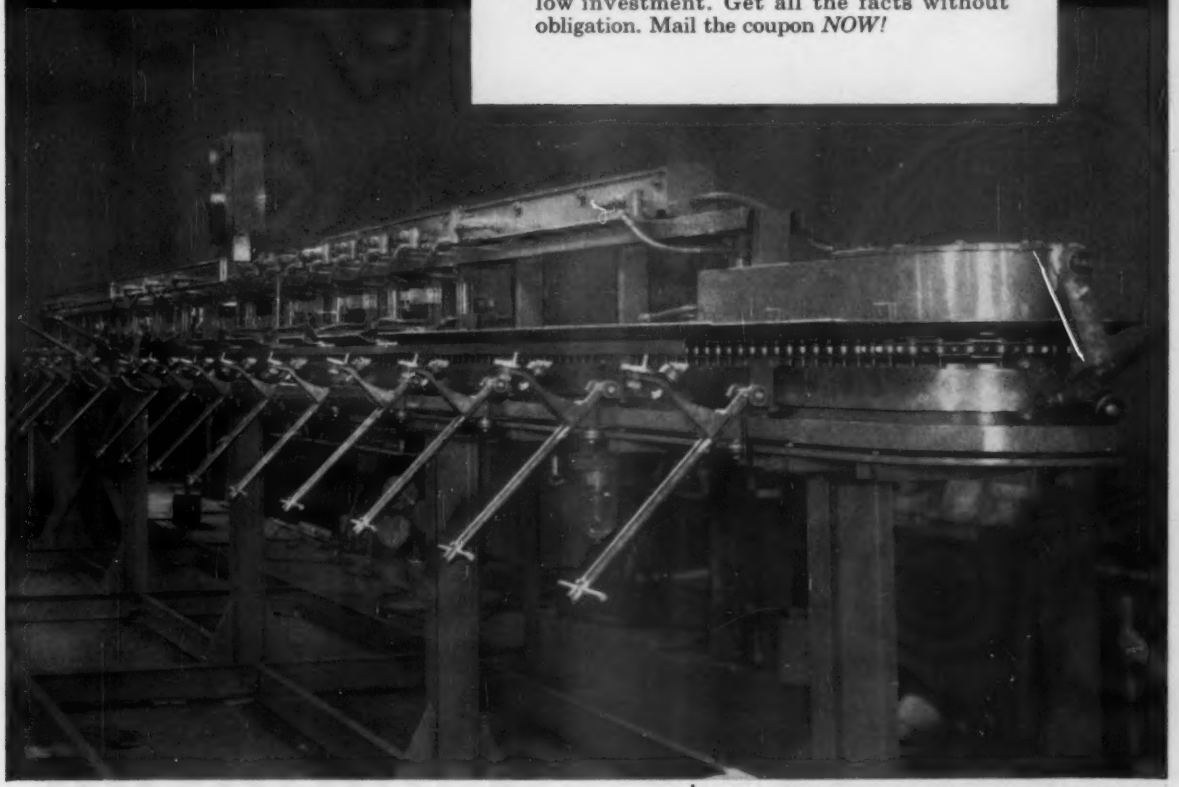
- √ With a Select-O-Matic, different machines for each cycle are unnecessary. Saving in equipment is tremendous. Maintenance is cut to a fraction. All the floor space saved can be put to more productive use.
- √ No matter what your type of operation, Select-O-Matic is easily adaptable—at a surprisingly low investment. Get all the facts without obligation. Mail the coupon *NOW!*



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- **SAVE MONEY** — Heavy-duty ½" thick panels at price of conventional ⅜" units. ⅜" and ¼" panels at **lower** prices (see below).
- **SUPER SERVICE** — Hi-performance synthetics, special Singleton Heat-Treated.* 30% stronger, more durable. 10°F. higher temperatures. *H-T Plexiglas, H-T Polypropylene, H-T Tempron.
- **BUILT TO LAST** — All-Welded, permanent, crack-proof seams.
- **HEAVY-DUTY REINFORCING "COLLAR"** — Welded around top rim. Prevents hi-heat distortion. Absorbs bumps.
- **BETTER TUMBLING** — Hexagon shape superior to round for effective agitating. Faster, better plating.
- **CONTINUOUS YOKE** — Increases structural strength, reinforces sides and bottom.
- **PROTECTED DANGLERS** — Cables secured to side edge of yoke arms by plastisol coated "guides", enter cylinder at side near bottom. Not exposed to operation hazards as on conventional units.
- **FASTER DRAINAGE, DRYING** — Capillary action, vertical drain slots speed drainage, prevent drag-out. Better drying within cycled time.

Boost Production and Quality from Your (Stevens) Automatics at Big Savings - - with Singleton Oblique Cylinders

Singleton (Stevens-type) Automatic Cylinder Price List

MODEL "C"

Model	Type		
SSAC	Steel Plastisol Coated		$125.00
SSAC	H-T Polypropylene or H-T Plexiglas	½" Panels	$225.00
SSAC	H-T Polypropylene or H-T Plexiglas	⅜" Panels	$195.00
SSAC	H-T Polypropylene or H-T Plexiglas	¼" Panels	$170.00
SSAC	H-T Tempron	½" Panels	$275.00
SSAC	H-T Tempron	⅜" Panels	$250.00
SSAC	Danglers (2 req.)		$ 4.25

MODEL "E"

SSAE	Steel Plastisol Coated		$195.00
SSAE	H-T Polypropylene or H-T Plexiglas	½" Panels	$285.00
SSAE	H-T Polypropylene or H-T Plexiglas	⅜" Panels	$250.00
SSAE	H-T Polypropylene or H-T Plexiglas	¼" Panels	$225.00
SSAE	H-T Tempron	½" Panels	$375.00
SSAE	H-T Tempron	⅜" Panels	$325.00
SSAE	Danglers (3 req.)		$ 4.50

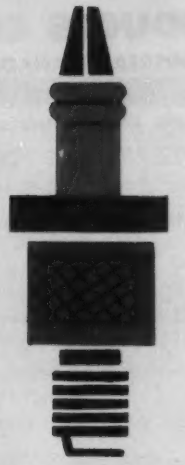
Standard 3/32" perforations or larger. Smaller perforations optional at slight extra cost. Yoke assemblies with dangler "guides" included. Danglers optional at list. Prices F.O.B. Cleveland, Ohio. Terms: Net 30 days. Prices subject to change without notice.

A full 30% greater value in performance and service! More advantages than any other cylinder of its type. Yet, thanks to design and manufacturing advances, it costs you **less.** Get the facts on this, and other **Singleton Replacement Cylinders** made of the toughest "synthetics" to fit all makes, types, sizes, ages of superstructures. **Singleton Cylinder-Superstructure Units** to fit existing installations — any make, type, size, age. **Singleton "Cogged-V-Belt" Drive (or gear) Plating Barrels,** and **Tanks** — single or multi-station, allied equipment and accessories; Corrosion Test Cabinets. Available exclusively through Singleton distributors. Send for data, prices, and name of nearby Singleton distributor.

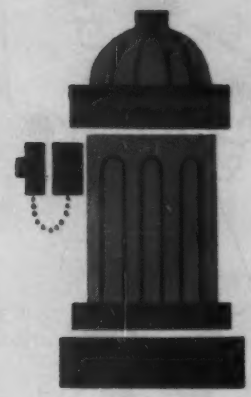
Singleton

Please contact **The Singleton Co.**, 11720 Berea Rd., Cleveland 11, Ohio.
Telephone: CLearwater 1-5580.

from Spark Plugs



to Fire Plugs



from Misses

to Missiles

Heatbath has a complete line of tested and proven chemical finishing products for all ferrous and non-ferrous metals. This line includes materials for cleaning, etching, deoxidizing, deburring, polishing, bright dipping, chromating, conversion coatings and surface protection. We'll be glad to process samples of your products or, if you prefer, send now for further information. Our technical engineers are at your service.

HEATBATH CORPORATION

SPRINGFIELD 1, MASS. or 701 North Sangamon St., Chicago 22, Ill.

39 Years of Service to the Heat Treating and Metal Finishing Industry

FOR THE FINISHING TOUCH!

LEA PRODUCTS COMPANY

996 DE BULLION ST., MONTREAL, CANADA Tel: UN 6-5418-9

Leading Canadian Manufacturer & Distributor Since 1936

COMPLETE LINE OF PLATING AND POLISHING EQUIPMENT & SUPPLIES

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DANIELS PLATING BARRELS INC. — Plating Equipment • BACON FELT CO. — Felt Products

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FEDERATED METALS OF CANADA, LTD. — Zinc & Cadmium Brighteners

"BRIGHTBOY PRODUCTS" — Rubber Bonded Polishing Wheels

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ABRASIVE BELTS • ANODE BAGS • ANODES • ABRASIVE GRAINS • ANODE BASKETS • BARREL FINISHING SUPPLIES • BACKSTAND IDLERS • BARREL FINISHING EQUIPMENT • BASKETS, DIPPING AND HANDLING • BUFFS • BARRELS, PLATING • BRUSHES, TAMPICO • BRUSHES, WIRE • COMPOSITIONS, LIQUID • COMMON CHEMICALS • CLEANERS, ALKALINE AND EMULSION • TESTING EQUIPMENT, LABORATORY • CARBOY ROCKERS • CEMENT POLISHING • ABRASIVE BLASTING EQUIPMENT • COILS AND PLATES • COMPOSITIONS, BUFFING AND POLISHING • CROCKS AND DRUMS • ELECTRIC IMMERSION DEGREASERS • DIP TANKS AND MACHINES • ELECTROPLATING AND ANODIZING EQUIPMENT • LACQUERS • RUST PREVENTIVES • FELT POLISHING WHEELS • POLISHING MACHINES, AUTOMATIC • FILTERING EQUIPMENT • LACQUERS AND ENAMELS • GLOVES, RUBBER AND CLOTH • SCRATCH BRUSHES • RACK COATING MATERIALS • RECTIFIERS • SALT SPRAY TESTING EQUIPMENT • TAPE • MASKING STRIPPERS • CONVERSION COATINGS • PERIODIC REVERSE EQUIPMENT • SAWDUST AND MAIZE • ULTRASONIC EQUIPMENT • TEMPERATURE REGULATORS AND INDICATORS • WHEELS, POLISHING

LEPCO BUFFING COMPOUNDS

WILL SAVE YOU TIME AND MONEY

LEA PRODUCTS CO. manufactures a fine grade of greaseless, Stainless Steel, Tripoli and Lime Compounds. We specialize in making compounds in liquid for spraying and for "unusual" jobs.

FEATURES

1. Open yoke hangers allow quick belt replacement without disassembling frame. Uses standard cog-belt.

2. Low profile for easier handling.

3. Self leveling horn bracket assures positive four point horn contact.

4. Cogged pulley drive eliminates belt slippage.

5. Plastisol coated hanger frames—impervious to chemicals. Other exposed metal coated with chemically resistant paint.

6. One piece cylinder shell formed of chemically inert polypropylene—reinforced with internal tumbling ribs.

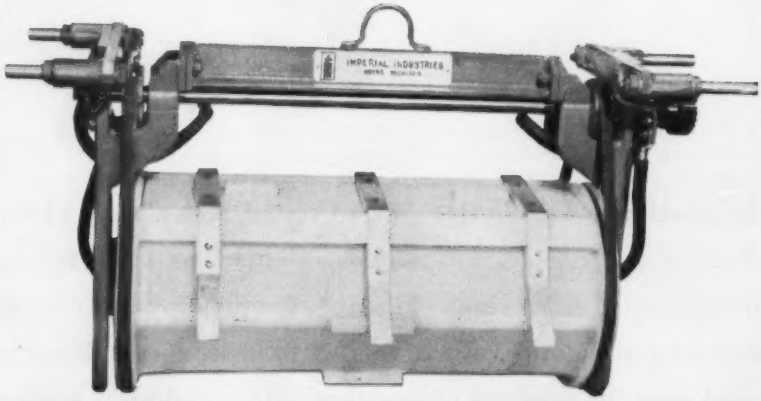
7. Titanium door clamps—impervious to chemicals.

Imperial's new horizontal plating barrels incorporate all advanced design features that speed production and minimize down time in plating operations. They adapt to all types of existing plating tanks.

✻ANOTHER FIRST FROM IMPERIAL!

NEW PLATING BARRELS

WITH 7 ADVANCED DESIGN FEATURES



Gear drive units also available. Write for details.

IMPERIAL INDUSTRIES *Inc.* 36000 Earl Street Wayne, Michigan

NUODEX introduces

a series of new high-performance plating baths to complement NUODEX certified plating chemicals.

Two years ago, Nuodex led the industry in bringing you the many advantages of certified metal purity and quality in nickel plating chemicals. Now, with the introduction of high-performance plating baths and brighteners, Nuodex offers you improved control in your plating operations. Each of these four new baths has been specifically developed to overcome and eliminate the more troublesome problems and headaches of nickel and copper production plating.

A new bright nickel process with high leveling properties, high throwing power, ease of control, excellent ductility. May be used with agitated or still bath processes.

A bright barrel process, it may be used in hot barrel solutions or in room temperature baths with equal effectiveness. Simple to maintain and control, it produces highly uniform, bright deposits.

Specifically designed to eliminate stress problems in nickel deposits, it acts as a modifier to reduce high tensile stress to zero or convert it to compressive stress. Produces extremely ductile plate.

This acid copper process has high throwing power, eliminates rough grainy deposits and "treeing" while promoting smooth, hard deposits of high ductility at rapid speeds.

Distributors in principal cities in the U.S.

NUODEX SPECIAL PURPOSE CHEMICALS **PRODUCTS DIVISION** ELIZABETH, NEW JERSEY

HEYDEN NEWPORT CHEMICAL CORPORATION

2 OPERATIONS SAVED.
On base of small waffle iron, 1 cut-down operation, and 1 hand coloring operation have been eliminated through the use of Superlume.

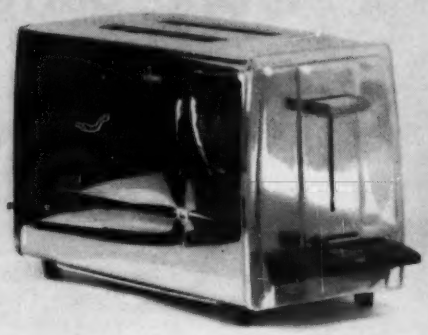
1 OPERATION SAVED.
On base of large waffle iron, 1 coloring operation is no longer necessary.

3 OPERATIONS SAVED.
On round toaster shell, 1 cut-down operation and 2 coloring operations have been eliminated.

1 OPERATION SAVED.
On the steam iron shoe, 1 hand coloring operation has been eliminated.

yet SUPERLUME vastly improves all 5 of these Son Chief products ...and at no extra cost.

says NICHOLAS J. LAZZARO, JR.
Asst. Plant Superintendent
in Charge of Finishing,
Son Chief Electrics, Inc.,
Winstead, Connecticut



HIGHER QUALITY FINISH.
On square toaster shell, same finishing operations are required with Superlume, but appearance of product is tremendously improved. On all 5 products, in fact, Superlume has stepped up product quality appreciably—and, in every instance, *at no increase in cost.*

Son Chief Electrics, Inc., appliance makers, sought a thicker, brighter plate, more rapidly applied. They found it in Superlume—along with major reductions in finishing operations, plus what Nick Lazzaro calls "Tremendous improvement in our products' appearance... a real breakthrough in quality."

Actually, Son Chief is plating *twice* as thick in the same time as before (using 60 amps per sq. ft. instead of 30).

They're plating flat pieces now and forming *after* plating... a big production advantage unique with highly ductile Superlume.

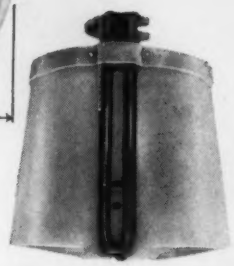
Superlume bath is easier to maintain. Son Chief's normal operating schedule is 5 days, 16 hours a day. But for two months every year, they work on a *24-hour/5-day basis.* Average pieces per hour through trouble-free Superlume: 336, with a low of 226, a high of 904. Son Chief plates 30 different parts ranging from 1 to 20 inches long. Superlume bath in use: 3100 gallons.

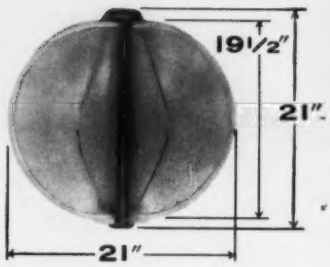
Good-sized operation... healthy benefits... no added production costs. For full facts on Superlume as applied to *your* operation, contact H-VW-M. Chances are you, too, will be better off with this better bright nickel bath.

H-VW-M
Progress in metalfinishing through advanced processes • equipment

Hanson-Van Winkle-Munning Company, Matawan, New Jersey
Offices in Principal Cities
Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco

STUTZ *EXCLUSIVE* OVAL-SHAPED BARREL

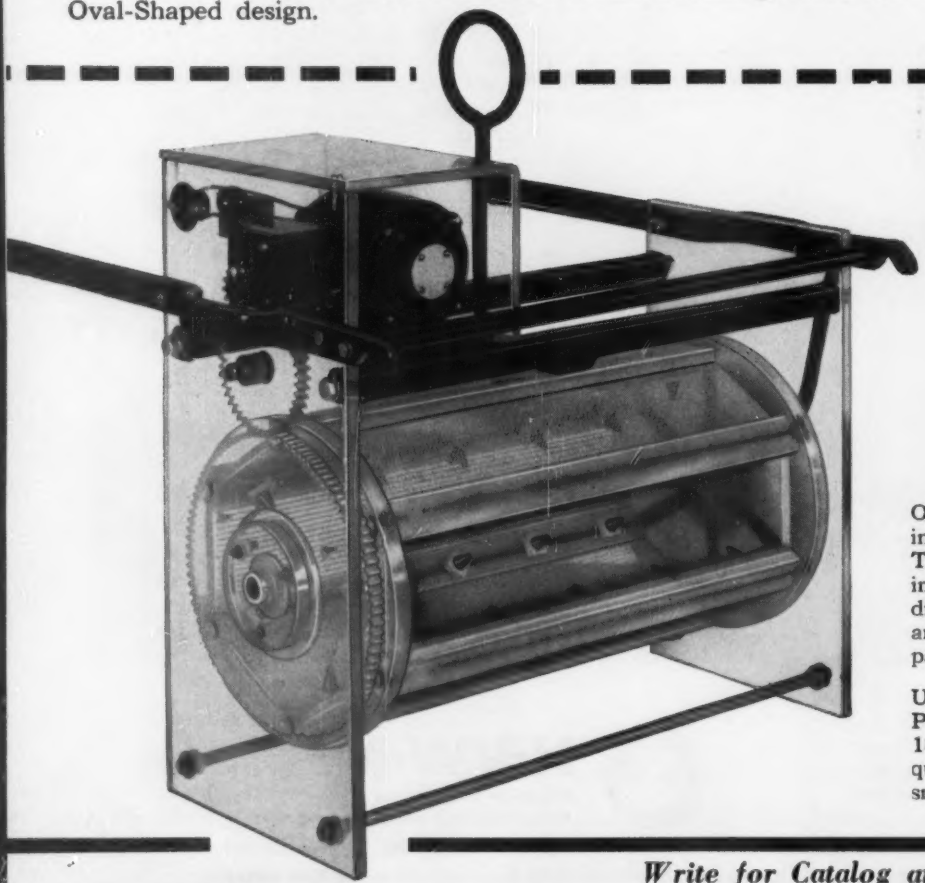




Stutz, the leader in Barrel Plating Equipment, presents an entirely new *Oval-Shaped Barrel* for use on Tub Type automatic barrel plating machines.

The Stutz Barrel, constructed of virtually indestructible *Polypropylene*, or *Linear Polyethylene* material, has a unique Oval-Shaped Top and a Convex Bottom. This design produces more convenient loading and unloading, greater load capacities and resulting increased production. The special design reduces dragout to a minimum as compared to previous obsolete designs.

Every user of this new barrel will vouch for the advantages received from this unique Oval-Shaped design.



PORTABLE Plating Barrel *with* CONE BUTTON CONTACTS

Offered for the first time, a Portable Plating Barrel with Cone Button Contacts. This type contact produces a perfect plating job on small delicate parts without distorting the parts. Barrel is of loose rib and panel design for easy replacement of parts, when necessary.

Units available in high temperature Plexiglas in either 6" x 12" I.D. or 8" x 18" I.D. sizes. Also special sizes upon request. Standard perforations are 3/32", smaller or larger openings are available.

Write for Catalog and Prices

The STUTZ Company

4430 West Carroll Ave. Chicago 24, Ill.

Serving Industry Over 40 Years

FOUNDATION *makes the difference!*

The Interlox line was developed to give you a better, lower cost, easily controlled phosphate coating. Its exceptional cleaning ability combined with a radically different type of accelerator produces an even, fine grained, dense coating which locks your organic finish to the metal.

Interlox eliminates streaks, stains, powdery deposits, and flash rusting, giving you the ultimate in appearance, adhesion and resistance to humidity and salt-spray.

Additional cleaning power is easily obtained, when desired, by the addition of a low-cost detergent only, thus avoiding the danger of over-phosphatizing and the costly practice of adding complete phosphatizing compound when only cleaner is required.

There is an Interlox product developed to meet your particular need whether spray or immersion type, single or multiple stage. Interlox baths are unusually long lived and require less additions and control.

Licensed Manufacturers

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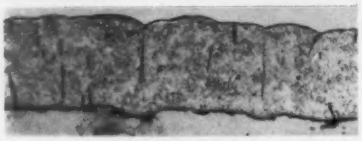
Armalite Company, Ltd. Toronto, Canada

NORTHWEST CHEMICAL COMPANY
9310 ROSELAWN • DETROIT 4, MICHIGAN
CHEMICAL PRODUCTS DIVISION • CHEMETRON CORPORATION

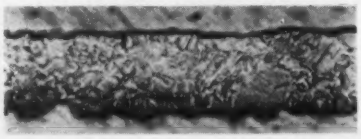
Call Du Pont: for better top-quality chemicals . . . timesaving

Now . . . you can deposit a level coat of copper on metal parts

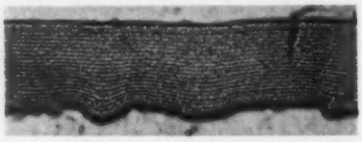
New process lowers finishing costs . . . improves appearance . . . provides an excellent undercoating for nickel and chromium.



1. Photomicrograph shows 0.001-inch copper plating on polished steel of 24 RMS. Conventional copper plating (above) shows uneven surface using direct current.



2. Du Pont's level-coating process with *interrupted current* shows amorphous structure and relatively level surface . . . satisfactory where maximum leveling is not required.

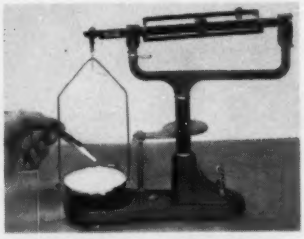


3. Same process with current reversal gives laminar structure, extremely level surface. *Current reversal* is employed where maximum leveling of surface is desired.

A combination of chemical additives and current variations form the basis of this new leveled copper plating method. Included are a high-efficiency cyanide copper bath and special Du Pont addition agents: Elchem 1396 and 1442M. The process can be easily and inexpensively adapted to most plating operations.

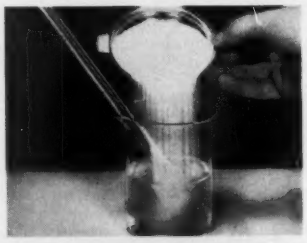
You'll avoid trouble and save time with new Du Pont double salts—

Sodium-Copper Cyanide and Potassium-Copper Cyanide

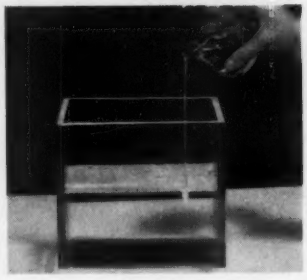


NEW DIRECT METHOD

1. You weigh required amount of Du Pont double salt instead of potassium or sodium cyanide *and* copper cyanide.



2. You dissolve double salt in water or plating solution. You eliminate steps of dissolving separate chemicals.



3. You add double salt directly to plating tank with no filtering necessary. Active ingredients are in proportions usually required. You save time, reduce handling, avoid waste and mixing errors.

The balanced composition of Du Pont double salts simplifies calculations required in making up new baths or replenishments. (1 oz. potassium-copper cyanide double salt equals 0.26 oz. copper, or 0.37 oz. copper cyanide; 1 oz. sodium-copper cyanide double salt equals 0.29 oz. copper or 0.41 oz. copper cyanide.) Both Du Pont double salts are packed in handy, moisture-resistant 100-lb. net fiber containers.

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electroplating at your plant... methods... dependable service

Two convenient forms of sodium cyanide 97%

ALL-PURPOSE CYANOBRIK®

—handy, pillow-shaped briquettes of 97% minimum sodium cyanide for all applications: plating, case hardening and chemical manufacture. Cuts inventory and purchasing problems. Made by a new Du Pont process, the briquettes are lower in moisture content and are more moisture-resistant than before.

CYANOGRAN® M

—granular, easily dissolved form of 97% minimum sodium cyanide. Ideal for dry compounding where uniformity of size is desired. "Cyanogran" M will pass through a 10 mesh screen; is retained on a 50 mesh screen. Absence of fines and dusting makes it easy to handle. It sells at the same low price as All-Purpose "Cyanobrik".

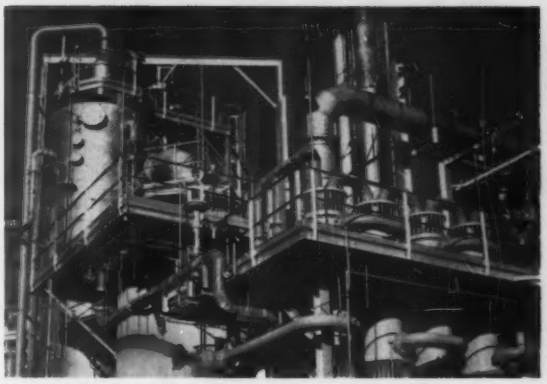
Du Pont sodium cyanides are highly suitable for cyanide electroplating solutions, including copper, brass, zinc and cadmium normally using sodium cyanide. Negligible sulfide content makes them especially attractive for use in sulfide-sensitive, bright copper baths. Specifications:

(NaCN-97% min.; NaCl-0.2% max.; Sulfides as S-0.0005% max.)

POTASSIUM CYANIDE

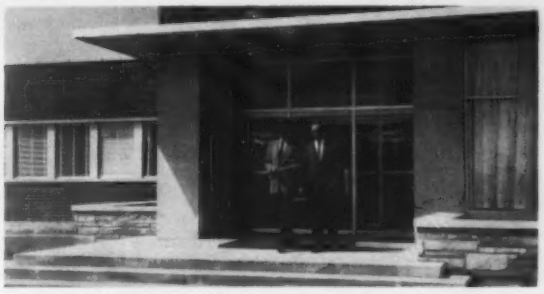
The extremely low sulfide content and high assay of Du Pont potassium cyanide make it ideal for all plating solutions in which potassium cyanide is specified. It is particularly suitable for use in modern bright cyanide copper, gold and silver plating baths. Specifications:

(KCN-98% min.; KCl-0.5% max.; Sulfides as S-0.0003% max.)



New modern plant assures reliable domestic source of supply

Centrally located in Memphis, Tenn., Du Pont's new chemical plant (above) is producing the high-quality sodium and potassium cyanides mentioned at left. This new source of supply means that you can depend on Du Pont to meet your needs quickly . . . at all times.



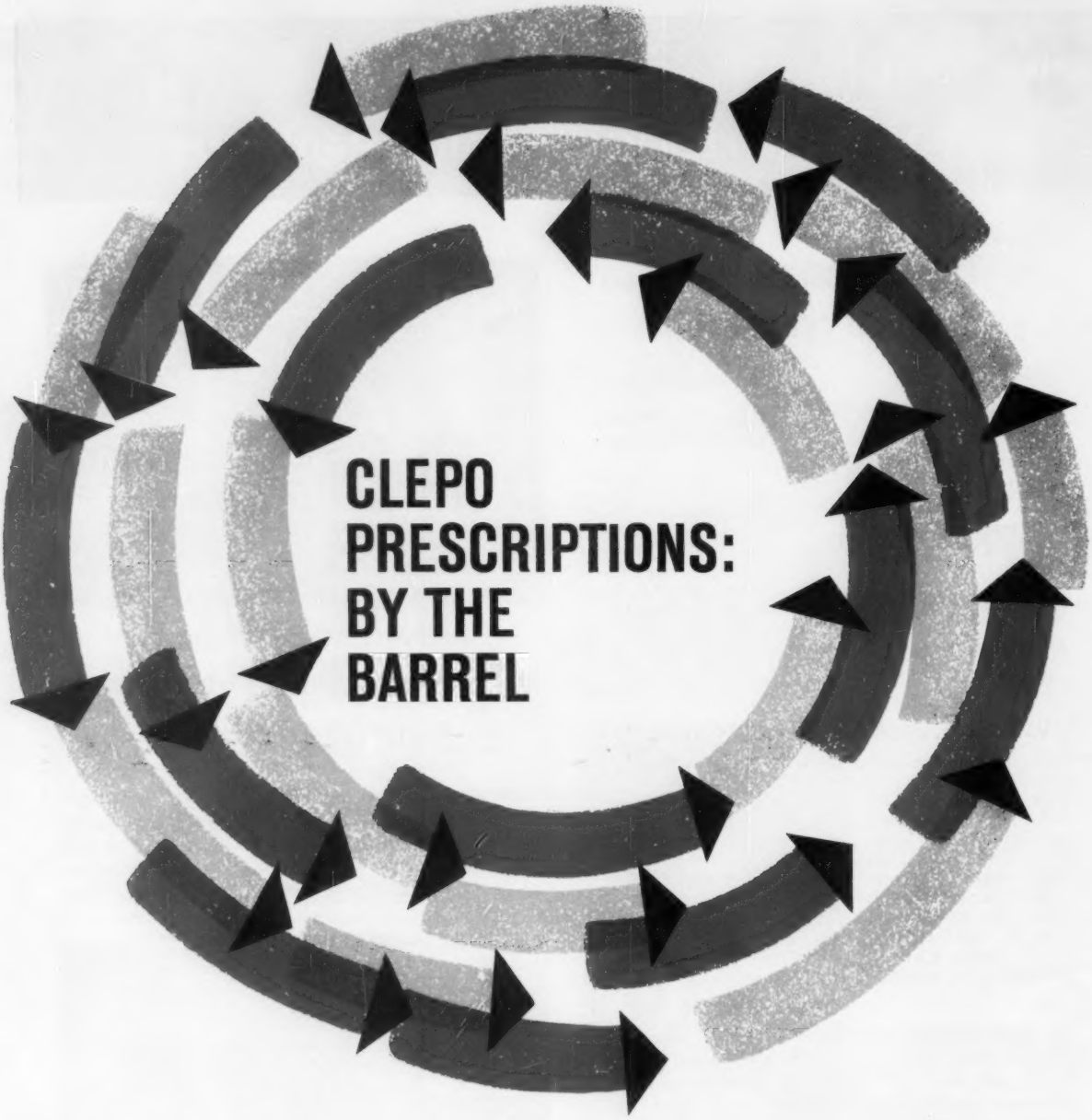
Technical service for you

Du Pont's nationwide staff of technical field men is ready to assist you whenever you ask for help. They're backed by a 2-million-dollar Sales Technical Laboratory in Wilmington, Delaware. All lab facilities are at your disposal. For more information on Du Pont electroplating chemicals and timesaving processes, call your nearest Du Pont representative (see below).

E. I. DU PONT DE NEMOURS & CO. (INC.)
ELECTROCHEMICALS DEPT.,
SODIUM PRODUCTS DIVISION
WILMINGTON 98, DELAWARE

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
... THROUGH CHEMISTRY



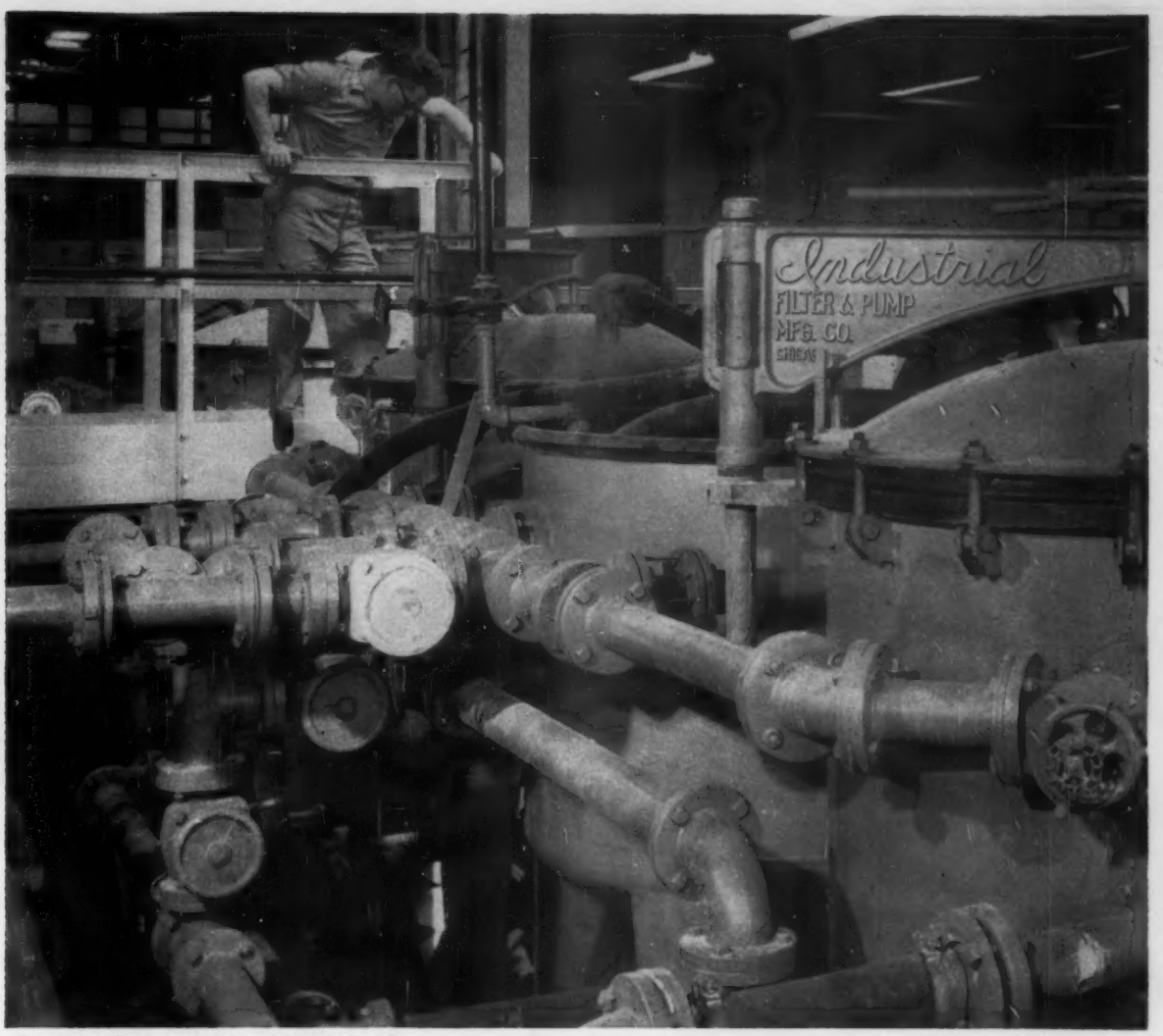
CLEPO PRESCRIPTIONS: BY THE BARREL

Gumm's twenty-eighth year of research and service is, as always, devoted to the single job of developing and improving CLEPO Products supplied to the Metal Finishing Industry. It is not surprising that we are continuously called upon, as specialists, to 'prescribe' for barrel finishing operations.

The resources represented by this entirely specialized experience are in two major categories: compound, *and* media for barrel finishing. This sound marriage of products undoubtedly accounts for our constant activity in prescribing 'by the barrel'.

Gumm's barrel tumbling pilot plant, research and development laboratory, testing and semi-production laboratory, are always available to *you*. If you want the advantages of the specialist's 'prescription', write or call

FREDERICK GUMM CHEMICAL COMPANY, INC.
538 FOREST STREET, KEARNY, NEW JERSEY



Eaton Manufacturing Company, Cleveland, Ohio

"SARAN LINED PIPE

installs 3 times faster than other pipe we've used!"

The Saran Lined Pipe above has carried more than 40,000,000 gallons of acid plating solutions at temperatures up to 160° F. In its 18 months of use, there's *not been a single failure* in the 1100 feet of Saran Lined Pipe at Eaton Manufacturing Company's Cleveland plant.

"In changing piping systems, our own maintenance men can put in Saran Lined Pipe with *no downtime* on our plating machines," says Mr. Harry Simpson, Maintenance Superintendent. "In fact, Saran Lined Pipe is so easy to cut and fit that we can't begin to estimate the total savings it's given us in time and labor, compared to other kinds of piping. We don't spend time waiting for a supplier to specially cut and rubber-line the pipe to fit our lines. We can put in Saran Lined Pipe three times faster than other piping—and indications are it will last substantially longer.

"In our experience, Saran Lined Pipe stands up extremely well under the hot muriatic and sulphuric acids we use and it has the strength and over-all economy we want."

For chemical processing plants, plating operations, and anywhere corrosive or reactive chemicals must be transferred, Saran Lined Pipe will give you one of the best and most durable piping systems obtainable. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field with a minimum of special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 1568CF12.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

CYANIDES

SODIUM CYANIDE
EGG FLAKE
GRANULAR POWDER

POTASSIUM CYANIDE
EGG POWDER

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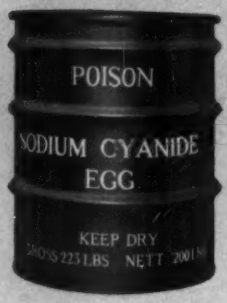

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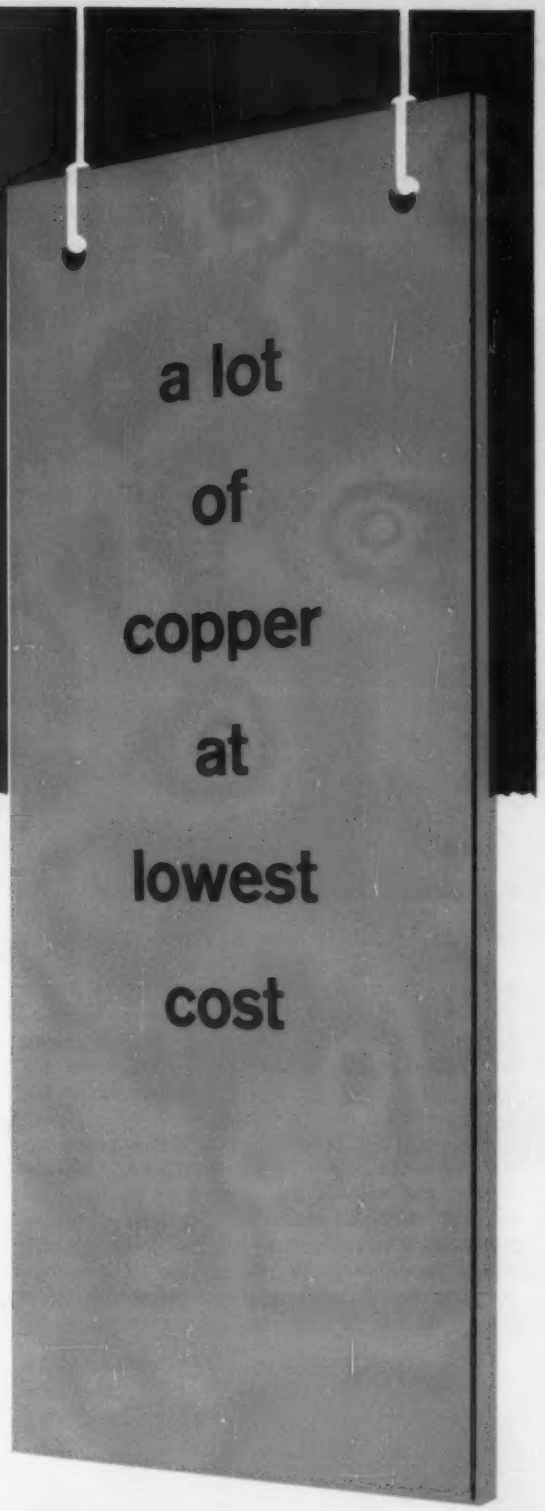

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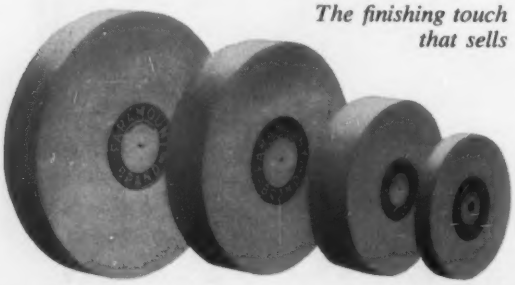

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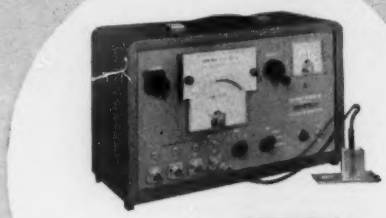

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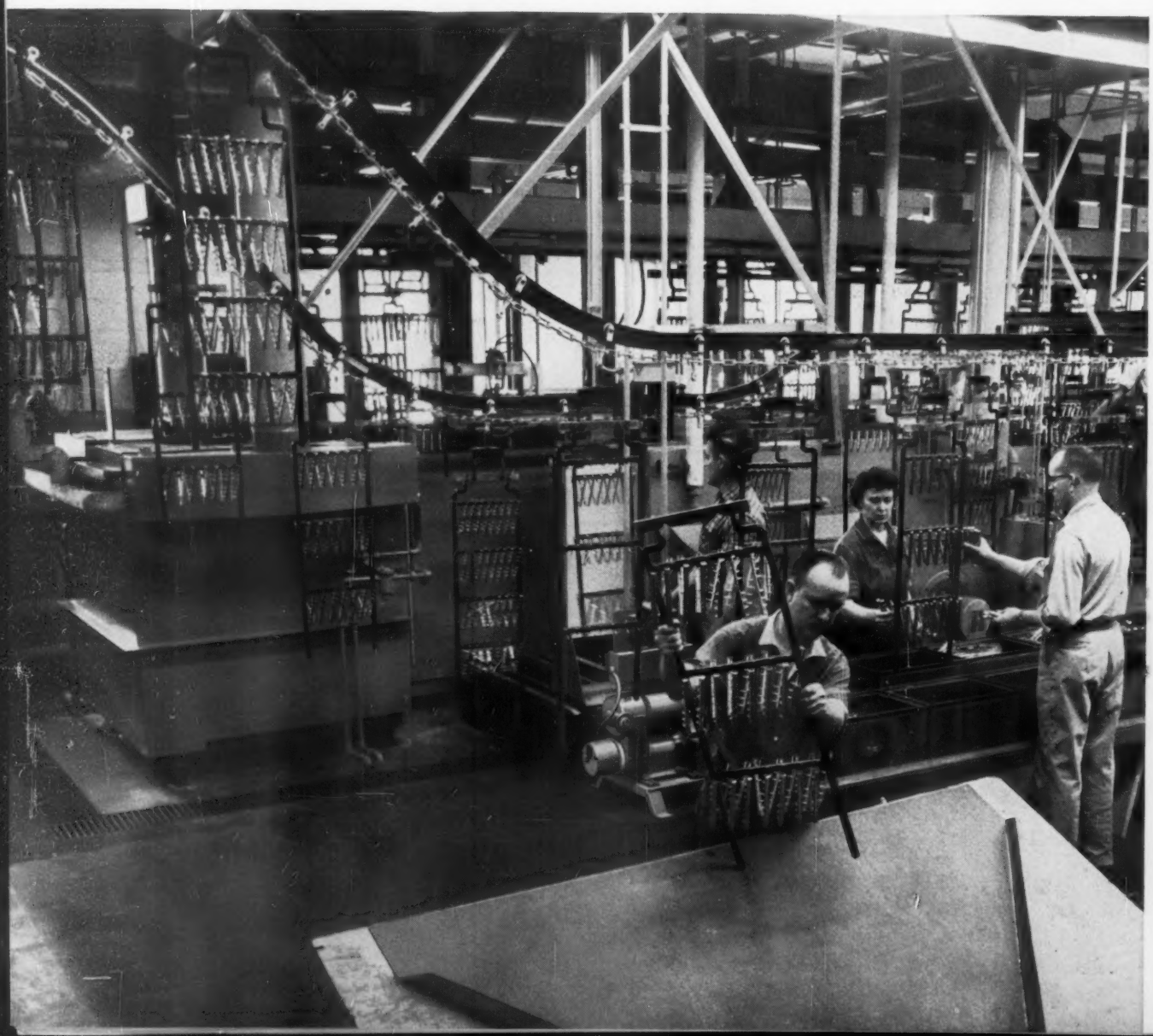

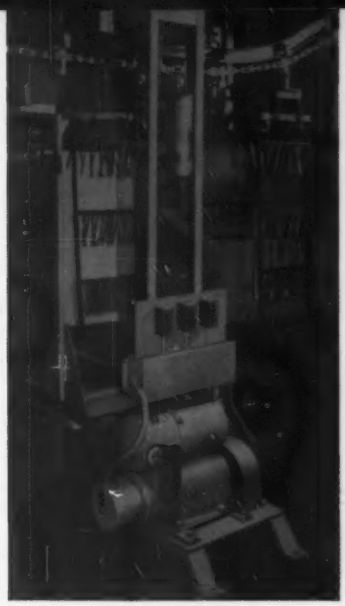

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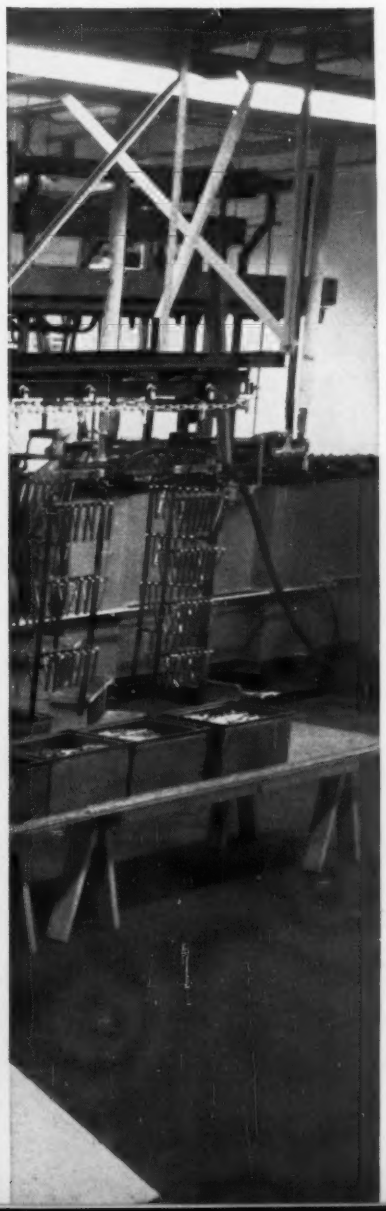

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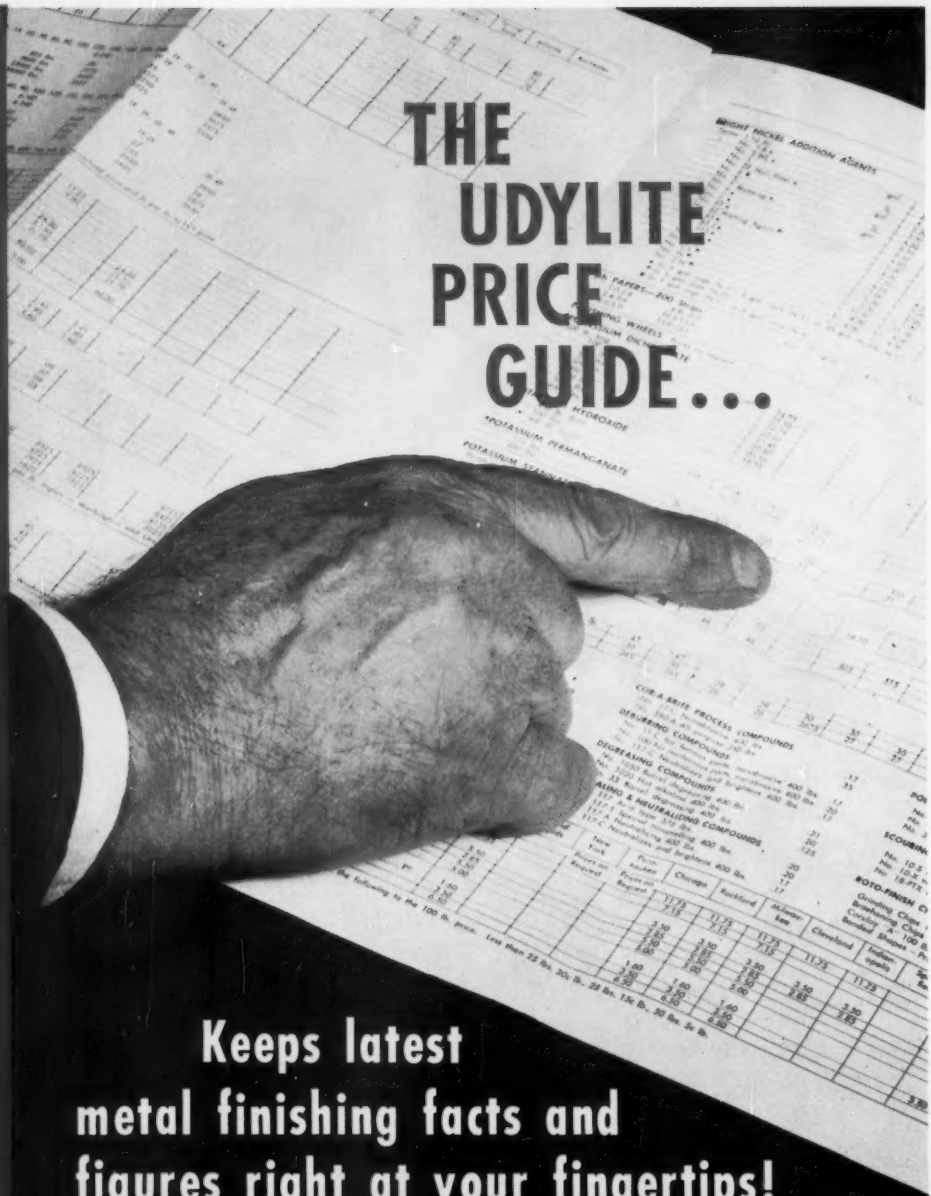

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DECEMBER, 1961 Volume 59 No. 12

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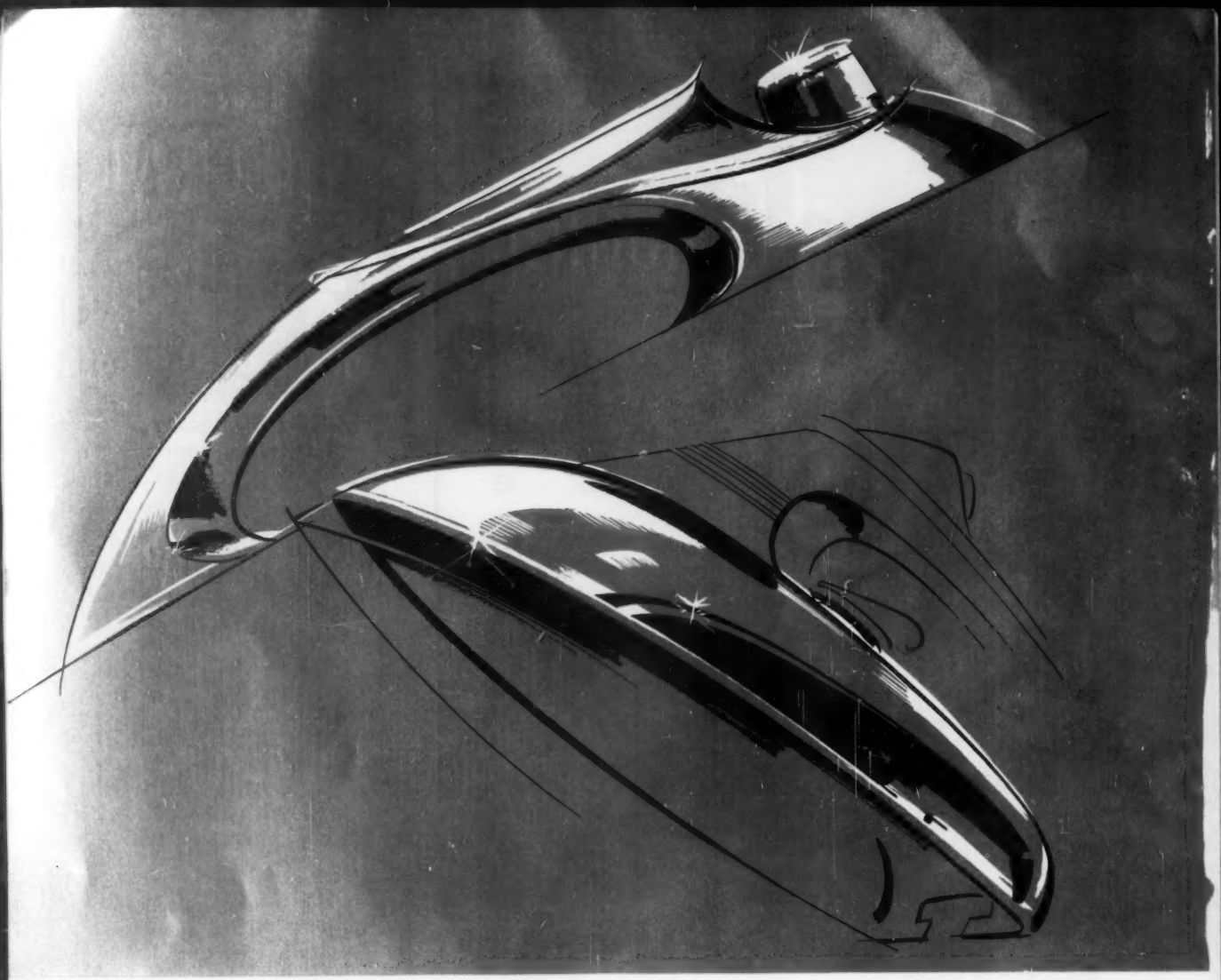

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"ALL I WANT FOR CHRISTMAS - - -"

The editor still has his two front teeth but, since this is the season when requests for benificence are in order, we have made up a list for the jolly fellow with the white beard, just in case he happens to be a subscriber and reads this page. Nothing to be delivered to us; all we want him to do is to whisper in certain ears as he makes his rounds on Christmas Eve, as follows:

The Scientist —When the boss suggests that you omit, from the paper you are going to present, all the pertinent information which distinguishes a technical report, dedicated to the advancement of science, from an advertisement for your company's proprietary process — At least put up a mild protest, even though you are reminded that your paper might win a prize anyhow. Use phrases such as "professional integrity" and point out that the advertising department is supposed to write the ads.

The Finisher — When you write the editor about your problem — Give him as much information as you can. Don't just tell him your finish is terrible and what should you do to correct it? Be specific. Also, remember that he has hardly enough time to send you copies of three hundred formulas when you ask for *all* available information on the subject of nickel plating solutions. Be reasonable.

The Publicist — Changing a bolt from carbon steel to stainless does not warrant a three page press release. Much as we love advertisers, present and prospective, the change does not comprise a piece of new equipment worthy of reporting in the "Recent Developments" section. Especially since the accompanying photo is the same one we published two years ago, when the equipment was really new. And, we suspect that not all of our readers are as vitally interested as you are in the appointment of a new assistant bookkeeper in the Walla Walla office of your company.

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Nathaniel Hall

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Wishes You A Very Merry Christmas and A Happy and Prosperous New Year

Electrodeposition of Tin-Lead Alloys from the Pyrophosphate Bath

By T. L. Rama Char and J. Vaid,* *Electrochemistry Laboratory, Dept. of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore, India*

ALLOYS of tin and lead have been deposited from fluoborate,[1,2] sulfamate,[3] chloride,[4] and phenolsulfonic acid[5] baths. It has been shown in this laboratory that the pyrophosphate bath is suitable for the plating of tin[6,7] and lead.[8,9] The preliminary work on the codeposition of tin with lead from this bath had been briefly reported.[8,10]

Experimental Procedure

The plating solutions were prepared from sodium pyrophosphate, stannous pyrophosphate and lead nitrate. The pyrophosphate concentration was in excess of that required for complex formation. The molar ratio of pyrophosphate $(P_2O_7)^{-4}$ to metal was 3 unless otherwise stated. Physiochemical measurements have shown that the metal ion concentration (g.ion/l) for the pyrophosphate complexes is of the order of 10^{-14} for tin and 10^{-11} for lead. The tin (stannous) was estimated by titration with standardized iodine solution after reduction with antimony powder, lead by gravimetric estimation as lead sulphate, pyrophosphate by the ammonium phosphomolybdate method, and orthophosphate by the method of Kolthoff and Stenger. The deposit was stripped from the cathode with concentrated hydrochloric acid (sp.gr. 1.17). The tin was estimated as above. For lead, the tin-lead solution was treated with nitric acid, filtered, the filtrate taken to fumes with concentrated sulphuric acid (sp.gr. 1.83), filtered and lead estimated as above.

*Present address: Electrical Industries Corporation, Calcutta.

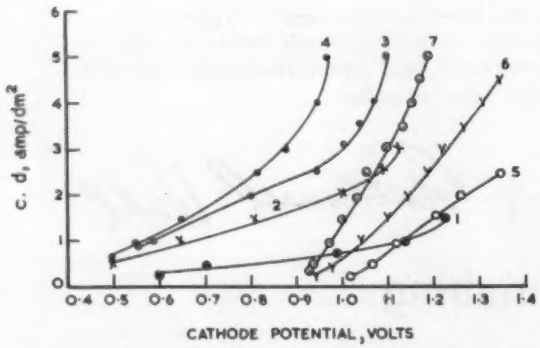

Fig. 1. Cathode Potential Curves for Tin and Lead. Ratio 3, temp. 60°C., agitation 1200 r.p.m., pH 9.0-9.5 throughout unless otherwise stated. (1) Pb 0.01M, (2) Pb 0.025M, (3) Pb 0.05M, (4) Pb 0.1M, (5) Sn 0.05M, (6) Sn 0.1M, (7) Sn 0.2M.

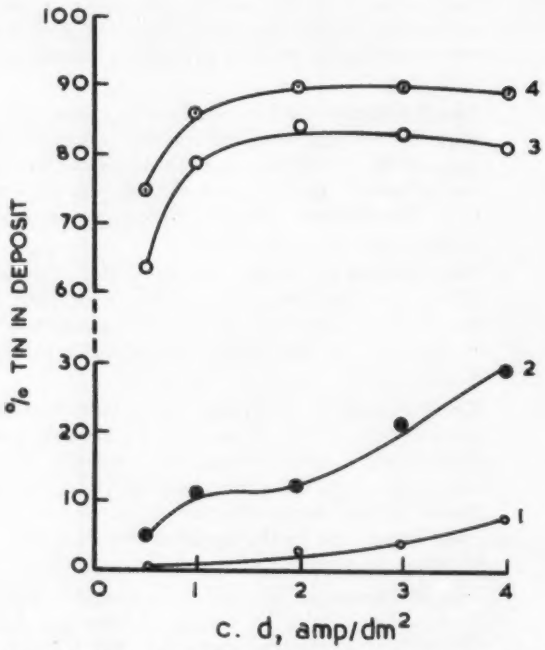

Fig. 2. Effect of Tin Concentration in Solution on Deposit Composition.
Anode 50% Sn alloy unless otherwise stated. Pb 0.05M, Sn: (1) 0.02M, (2) 0.15M, (3) 0.2M, (4) 0.3M.

Fresh solutions, 175 to 200 ml. of one concentration, were taken for each experiment — determination of current efficiency, deposit composition, and electrode potential at a given current density. The same solution, however, could be used for determinations at a number of current densities. A cylindrical hollow cathode of platinum or other metal (1½" high x ⅝" diameter) slipped over a stainless steel rod was placed inside a hollow, cylindrical alloy anode (1" high x 1⅝" diameter x ¼" thick). The interelectrode distance was ½ inch. Cast alloy anodes containing 10 and 50 per cent tin were used, the anode area being four times the cathode area. A major portion of the work was carried out with the 50 per cent tin composition. The plating was carried out with rotating cathodes (1200 r.p.m.), as the deposits were loose and the limiting current density was low under still conditions. The plating time varied from 10 to 60 minutes.

The cathode efficiency was determined by the usual method for alloys.[2] The Kohlrausch bridge was used

for specific resistivity measurements. The pH was measured with a glass electrode. Conditions were carefully controlled to obtain electrode potential values (hydrogen scale) to an accuracy of ±0.005 v. The data, however, have been presented to the second decimal place, the sign of the potential being negative throughout unless otherwise stated. A decrease in the cathode potential means that the potential is less negative. The conventional throwing number was calculated from the equation of Gardam[11] for a linear relationship between cathode potential and current density. The thickness throwing power was measured by using the bent cathode[12] test. Photomicrographs of the surface of a thick coating (0.001") of the deposit were taken with a Vickers projection microscope. X-ray powder patterns of the deposit were obtained with a Siemens Baujahr 1950 Model X-ray Unit and a 57.3 mm. diameter camera. Chromium K∝ radiations with vanadium filter, at 25 KV and 18 milliamperes were utilized. Hardness measurements were made on the surface of the deposit with Leitz 1151 Durimet Midget Hardness Tester.

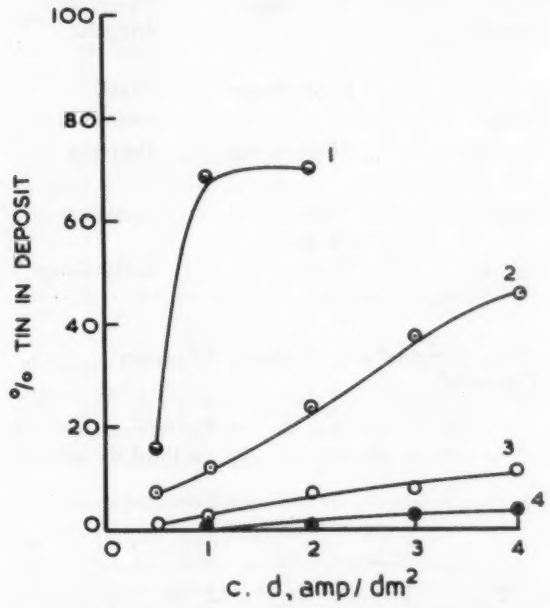

Fig. 3. Effect of Lead Concentration in Solution on Deposit Composition.
Sn 0.1M, Pb: (1) 0.01M, (2) 0.025M, (3) 0.05M, (4) 0.1M.

Experimental Results

Fig. 1 presents the cathode potential curves for tin and lead at different concentrations. The two curves are close and also intersect in a few cases, indicating the possibility of codeposition.

Alloy deposition was carried out under different conditions with respect to electrolyte concentration, addition agents, temperature and agitation. A detailed study was made of the effect of the variables on plate composition, cathode efficiency, and cathode potential. The results have been presented in Figs. 2 to 10 and Tables I to IV. The cathode efficiency was close to

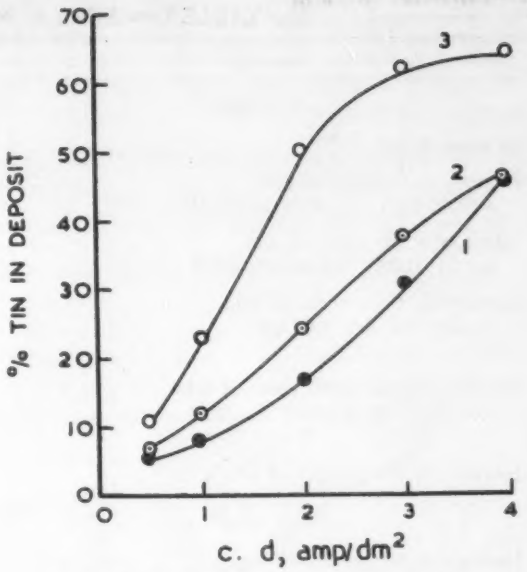

Fig. 4. Effect of Temperature on Deposit Composition.
Sn 0.1M, Pb 0.025M, pH 9.0. Temp.: (1) 40°C., (2) 60°C., (3) 80°C.

100 per cent under all conditions, and the values have not been recorded except in Table II. To avoid overlapping, part of the data obtained are omitted from the figures and tables. The recorded data correspond to good quality deposits. The effect of the variables on alloy deposition is summarized in Table I, and Table II shows the effect of the addition agents.

The bath gave adherent, smooth, and fine-grained deposits, the color ranging from white to grey with a decrease in tin content. The bath was stable under the experimental conditions. The performance of the alloy anodes was satisfactory, as substantiated by the control experiments summarized in Table III, and the anode potential curves of Fig. 8. The solutions could be used for several runs and aging up to six months

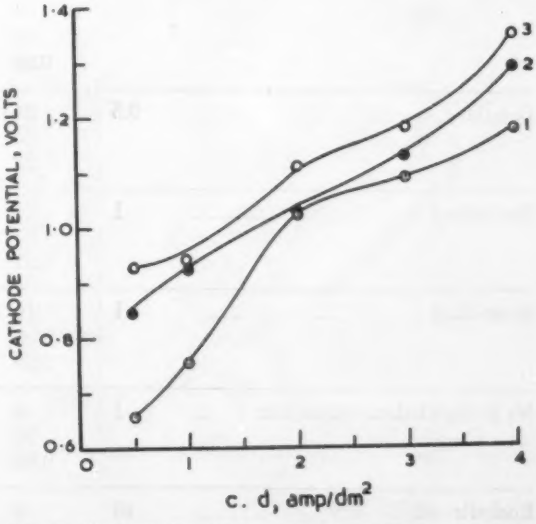

Fig. 5. Effect of Tin Concentration in Solution on Cathode Potential.
Pb 0.05M, Sn: (1) 0.02M, (2) 0.1M, (3) 0.15M.

TABLE I — *Effect of Variables on Alloy Deposition*

Variable	*% Sn in deposit*	*Limiting c.d.*	*Cathode potential*
Fig. No.	2-4	2-4	5-7
Increase in c.d.	Increase	—	Increase
Increase in Sn conc. of soln. —0.02, 0.05, 0.1, 0.15, 0.2, 0.3M	Increase	No change	Little change
Increase in Pb conc. of soln. —0.01, 0.025, 0.5, 0.075, 0.1M	Decrease	Little change	Decrease
Increase in P_2O_7 conc. of soln. —ratio 2.5, 3.0, 3.5, 4.0	Increase at higher c.d.	No change	Increase
Increase in total metal conc. of soln. —0.075, 0.15, 0.225M	Decrease at higher c.d.	No change	Decrease
Increase in Sn content of anode —10 and 50%	Slight increase	No change	Variation irregular
Increase in temperature — 40, 50, 60, 70, 80°C.	Little change	Little change	Slight increase
Agitation — 600, 1200 r.p.m.	Decrease	Little change	Decrease
Addition agents			
Gelatin, β-naphthol	Increase	Increase (gelatin)	Increase
Sulfonate	Increase	Increase	Little change

TABLE II — *Effect of Addition Agents on Alloy Composition, Cathode Efficiency and Cathode Potential*

Electrolyte: Sn 0.10M, Pb 0.05M, pH 9, bath voltage 0.2-1.3 volts. In each case the first figure under current density gives the Sn % by weight in the deposit, the second the cathode efficiency %, and the third the cathode potential in volts.

Addition agent	*Conc. g./l.*	*c.d., amp./dm.²* 0.5	1	2	3	4	5	6
Nil		1	3	7	8	12		
		94	96	98	100	98		
		0.85	0.93	1.03	1.13	1.29		
Gelatin	0.5	24	37	51	57	61	66	68
		66	63	62	68	69	74	77
		1.22	1.34	1.45	1.55	1.66	1.78	1.73
Resorcinol	1	1	4	8	13	18	24	
		97	100	100	100	100	100	
		0.61	0.80	1.07	1.17	1.25	1.33	
β-naphthol	1	16	24	29	34	40		
		96	97	99	100	100		
		0.99	1.09	1.24	1.33	1.41		
Na β-naphthalene sulphonate	1	4	5	9	13	21	26	34
		94	99	99	100	100	100	100
		0.92	0.96	1.09	1.17	1.29	1.39	1.49
Rochelle salt	10	0	1	1	10	13	19	28
		94	99	100	100	100	100	100
		0.61	0.65	0.77	1.12	1.19	1.28	1.45

TABLE III

Control Experiments

Electrolyte: Sn 0.1M (11.8 g./l.), Pb 0.05M (10.4 g./l.), pH 9, sp. resistivity 9.9 ohms/cm,[3] vol. of electrolyte 175 ml., c.d. — cathode 3 and anode 0.75 amp./dm.[2] Change in pH, sp. resistivity and pyrophosphate — not appreciable after electrolysis.

Anode % Sn	*Plating time, mins.*	*% Sn in deposit*	*Efficiency %*		*Change in metal conc., g./l.*	
			Cathode	*Anode*	*Sn*	*Pb*
10	13	7	98	102	+ 0.10	— 0.10
50	20	8	99	100	+ 0.06	0

had little effect on their performance. The orthophosphate in the solution was practically negligible. Coatings thicker than 0.0005" could be obtained. They were resistant to corrosion by the laboratory atmosphere (1 to 2 years) and did not change much in appearance or color. The total metal content was 99.9 to 100 per cent.

OPERATING CONDITIONS:

Table IV gives the operating conditions for obtaining satisfactory deposits over a wide composition range, together with the plating characteristics under optimum conditions for the pyrophosphate and fluoborate bath for tin-lead deposition. The data recorded for the fluoborate bath have been taken from literature[1,2] and some values which were not available have been experimentally determined. There is little difference in the performance of the two baths. The results indicate that the pyrophosphate bath is suitable for the plating of alloys of tin with lead.

Discussion

ALLOY COMPOSITION:

The tin content of the deposit could be increased by an increase in the tin or decrease in the lead concentration of the solution, increase in current density and decrease in the rate of agitation (Figs. 2 to 4). The addition of gelatin, beta-naphthol and sodium beta-naphthalene sulfonate to the plating solution under optimum conditions increased the tin content of the alloy, whereas the other substances had little effect (Table II). The ratio of the concentration of the two metals in the plating solution is quite reasonable, in order to obtain alloys over a wide composition range. It is necessary, however, to use a higher ratio of tin to lead in the solution in order to obtain alloys with a high tin content. In the fluoborate bath[1,2] the metal ratio appears to be proportional to that in the deposit.

CATHODE EFFICIENCY:

The cathode efficiencies with which pure tin is deposited from a stannous pyrophosphate solution and lead from a lead pyrophosphate solution are close to 100 per cent, and the alloy also deposits at this value under all conditions. The addition of 0.5 g./l. gelatin to the optimum concentration bath considerably decreases the cathode efficiency (Table II). Under op-

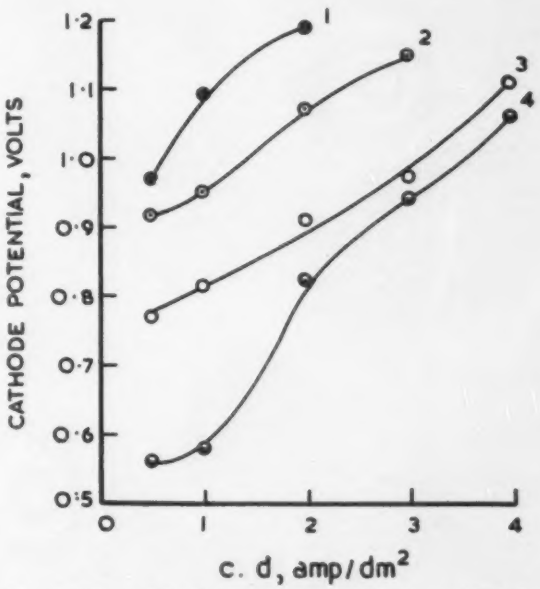

Fig. 6. Effect of Lead Concentration in Solution on Cathode Potential.
Sn 0.1M, Pb: (1) 0.01M, (2) 0.025M, (3) 0.075M, (4) 0.1M.

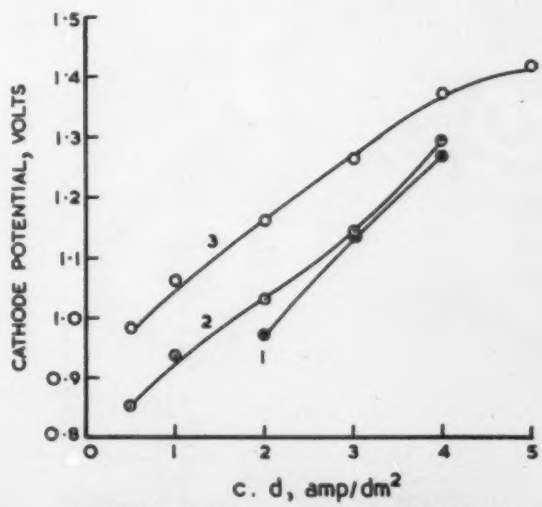

Fig. 7. Effect of Temperature on Cathode Potential.
Sn 0.1M, Pb 0.05M, pH 9.0. Temp: (1) 40°C., (2) 60°C., (3) 80°C.

TABLE IV
Operating Conditions

	Pyrophosphate		Fluoborate
	Range	*Optimum*	
Bath composition, g./l.			
Stannous pyrophosphate	4.1-61.7	20.6	Tin 38.4
Lead nitrate	3.3-33.1	16.6	Lead 48.5
Pyrophosphate $(P_2O_7)^{-4}$	39.2-261.8	78.3	Free fluoboric acid 30.0
Tin	2.4-35.6	11.9	Free boric acid 13.0
Lead	2.1-20.7	10.4	
pH	9.0-9.5	9.0	3.0
Temperature, °C.	40.80	60	25
Sp. resistivity, ohms/cm³	6.2-15.7	9.9	4.1
Bath voltage, v.	0.2-1.9	0.2-1.3	0.1-0.7
Agitation, r.p.m.	600, 1200	1200	—
Cathode	Pt, Cu, Steel		Cu, brass, steel
Anode, % Sn	10, 50	50	alloy
Cathode c.d., amp./dm.²	0.5-5.0	0.5-4.0	0.5-6.0
Anode c.d., amp./dm.²	0.1-1.3	0.1-1.0	0.5-6.0
Cathode efficiency, %	90-100	94-100	100
Anode efficiency, %	close to 100	100, 102	100
Cathode potential, v.	0.56-1.57	0.85-1.29	0.25-0.40
Throwing number	—	0.013	0.008
Deposit			
Composition, % Sn	0-90	1-12	3-45
Hardness, Vickers	13-10	13-11	11 (23% Sn)
Time to deposit 0.001", (min. at 3 amp./dm.²)	—	15	—

timum conditions, the limiting current density values for tin, lead and the alloy are 5, 5 and 4 amp./dm.² respectively.

CATHODE POTENTIAL:

The cathode potential during alloy deposition increased with increase in current density, and decreased with increase in the lead concentration of the solution and by agitation (Figs. 5 to 7). Gelatine and beta-naphthol increased the potential values. The plating solutions possessed good throwing power as observed visually. The distribution of the deposits on bent cathodes[12] was uniform except at the extreme edges. Analysis of the alloy, at points corresponding to the middle of the arms of the bent specimen, indicated

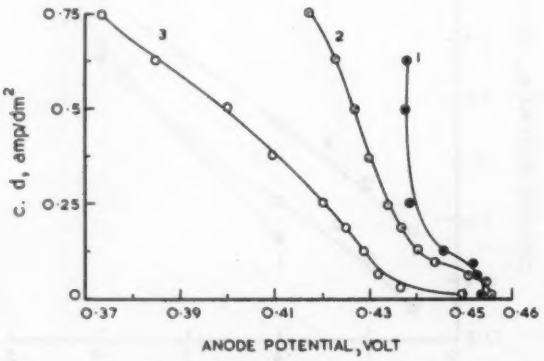

Fig. 8. Anode Potential Curves.
Anode c.d. is given. (1) Sn anode in solution of Sn 0.1M, (2) 50% Sn anode in solution of Sn 0.1M, Pb 0.05M, (3) 10% Sn anode in solution of Sn 0.1M, Pb 0.05M; and Pb anode in solution of Pb 0.05M.

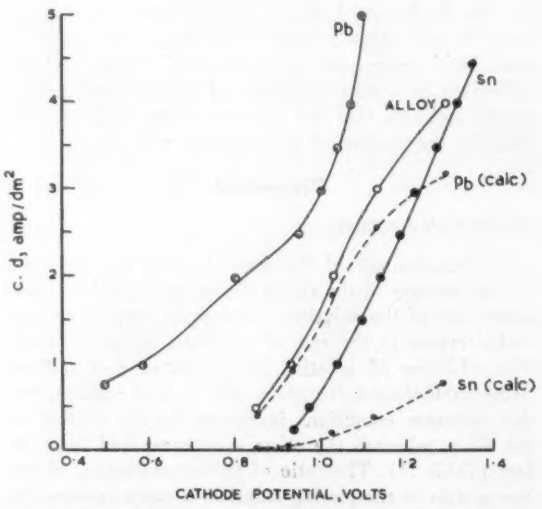

Fig. 9. Reconstruction of Single Metal Potential Curves from Alloy Composition and Potential.
Bath Composition: Sn—0.1M, Pb—0.05M, Alloy—Sn 0.1M, Pb 0.05M.

uniformity of composition. The deposition potentials for tin, lead, and tin-lead alloy in pyrophosphate solutions under optimum conditions are 0.82, 0.58 and 0.50 volt respectively. An alloy deposit with a high lead content is to be expected at low current densities, as is borne out by the experimental results. The relationship between cathode potential and current density was linear (Fig. 9).

From the alloy potential and composition it is possible to determine the proportion of the current that is used in the deposition of each metal and to plot

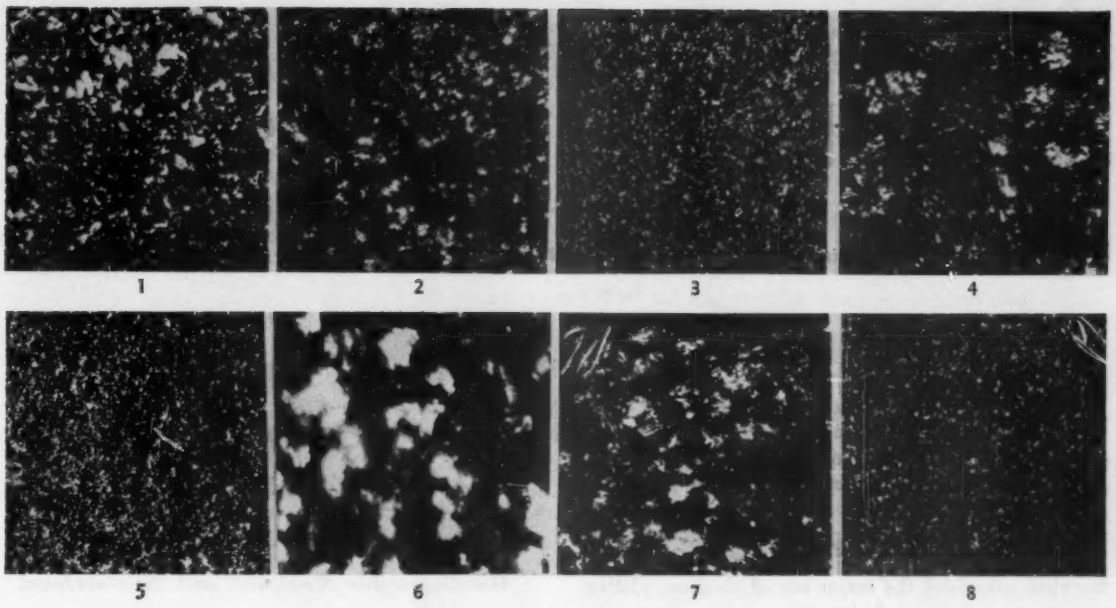

Fig. 10. Photomicrographs of Deposits.

Copper base, magnification 1 x 500. Plate 1, Sn only; Plate 2, 86% Sn; Plate 3, 51% Sn (with 0.5 g./l. gelatin); Plate 4, 23% Sn (fluoborate bath); Plate 5, 7% Sn; Plate 6, 7% Sn (fluoborate bath); Plate 7, Pb only; Plate 8, Pb only (with 0.5 g./l. gelatin).

corresponding potentials for each. Calculations of this nature, wherever possible, will give a fairly quantitative picture of the extent of influence of one metal over the other during alloy plating. Studies of this type have been made in this laboratory for the deposition of alloys of tin-cobalt and several others from the pyrophosphate bath.[13] Fig. 9 presents the cathode potential curves of the tin-lead system under optimum conditions: alloy potential, single metal potentials — observed and calculated. The reconstructed curves show that, due to the influence of tin over lead and vice versa, there is an appreciable polarization for the deposition of tin as well as lead. The relative position of the reconstructed curves also indicates the possibility of codeposition. The alloy curve is closer to the calculated curve for lead, indicating that a deposit with a high lead content is to be expected. This is in agreement with the results. Tin behaves as the baser metal of the system.

STRUCTURE OF DEPOSITS:

The photomicrographs in Fig. 10 show that the electrodeposited alloy is finer-grained than either of the single metals. The addition of gelatin makes the deposit finer-grained (Plate 3), as for lead deposit alone (Plates 7 and 8). The deposits from the pyrophosphate bath are finer-grained than those from the fluoborate bath (Figures 2, 4 to 6). X-ray studies of the deposits showed the structure for both the metals, the intensities of the lines depending upon the composition. From high tin to high lead, the lattice values varied from: for the b.c.t. structure, $a = 5.793 - 5.720$, $c = 3.159 - 3.115$; f.c.c. structure, $a = 4.964 - 4.939$.

ANODE CORROSION:

Anodes of tin,[6,7] as well as lead[8,9] corrode satisfactorily in pyrophosphate solutions, the efficiency being close to 100 per cent. The potential curves of Fig. 8 and the control experiments of Table III show that the anode behavior is normal for tin-lead alloys of both compositions. It is easy to maintain the bath composition during electrolysis. Alloy anodes have been used during deposition from fluoborate,[1,2,14] chloride[4] and phenolsulfonic acid[5] baths.

Acknowledgement

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Rhodium Plating Thickness Measurements

By Leonard Maisel, *Chemical Materials & Finishes Engineer, General Electric Co., Schenectady, N. Y.*

RHODIUM for use in electroplating has been available commercially for some thirty years. In general, it may be said that only acid electrolytes will give a bright, white deposit and, at the same time, show good throwing power. These fairly strong acid solutions are phosphates, phosphate-sulfate and sulfate. Before the current application and developments in the electronic field, the major use of rhodium plating was in the jewelry and decorative fields where only flash coatings are used (0.000001"-0.000010"). In the past ten years the industrial use of rhodium has increased tremendously, with applications running the gamut from thin jewelry flashes to 0.001" for use on electrical contacts subject to severe friction and/or corrosion. Hardness values of 540 to 640 Vickers (20 g. load) have been measured. The hardness of rhodium plate increases as thickness is increased, with deposits in the order of 0.001" or more having higher values than hard chromium or even some carbides. The wear resistance of rhodium electroplates, 0.00001" or less in thickness, seems to be about midway between that of nickel and chromium. The hardness and wear resistance have been used to great advantage on light reflectors; its wear resistance, combined with its freedom from corrosion, and high conductivity, also makes rhodium extremely valuable for electrical contacts. (The electrical resistivity for rhodium at 20°C. is 4.51 microhm-cm, and for silver it is 1.59 microhm-cm). Depending on the application, thickness of rhodium electroplate on electrical contacts ranges from 0.000005" to 0.0001" with light duty contacts frequently plated with 0.000015" of rhodium over 0.0005" of silver.

The following chart gives tentative values for general guidance as to thickness specifications:

Rhodium Electrodeposit Thickness Chart[2]

General Application	*Required Thickness Inches*
Decorative finish	0.000001 - 0.000005
Reflectors	0.000010 - 0.000015
Tarnish prevention	0.000005 - 0.000010
Light-duty electrical contact	0.000005 - 0.000020
Corrosion protection	more than 0.000010
Severe corrosion protection	more than 0.0001
Heavy-duty electrical contact	more than 0.000010
Severe wear electrical contact	more than 0.000020
Infrequently used contact	more than 0.000020

Very pertinent to the subject of thickness measurements is the cost of rhodium plating. Estimates as to cost may be calculated from the following data:[7]

1. $0.21 per 0.000001" per square foot deposited.
2. 0.000005" = 1mg. rhodium per square inch.
3. 1 mg. rhodium costs approximately $0.008.

Metallographic Mounting and Measurement

This method of measurement is destructive in nature and, naturally, requires preparation of a metallographic mount. In the preparation of electroplated specimens, a protective plate of nickel or silver is usually applied, to aid in preserving the sharp edges of the film under scrutiny. A hard epoxy resin has been tried with little success. Another attempt to measure the thickness by the use of a metallograph

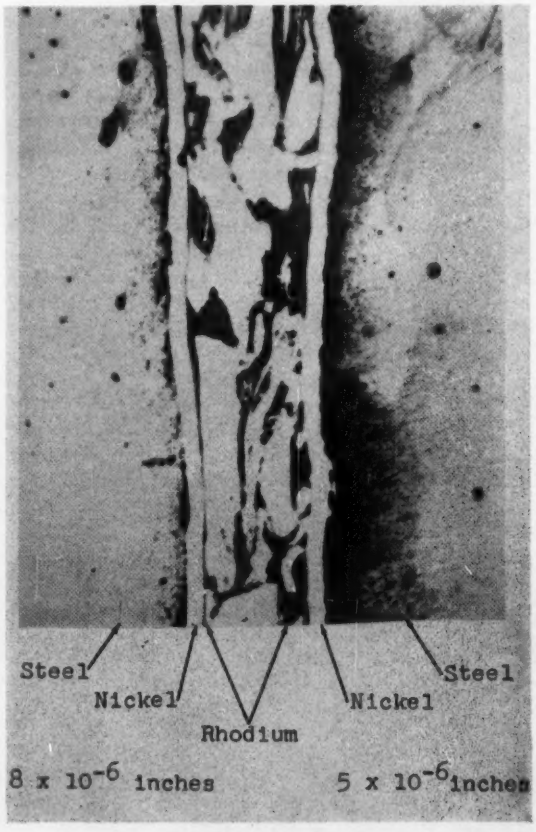


Fig. 1 (X750)

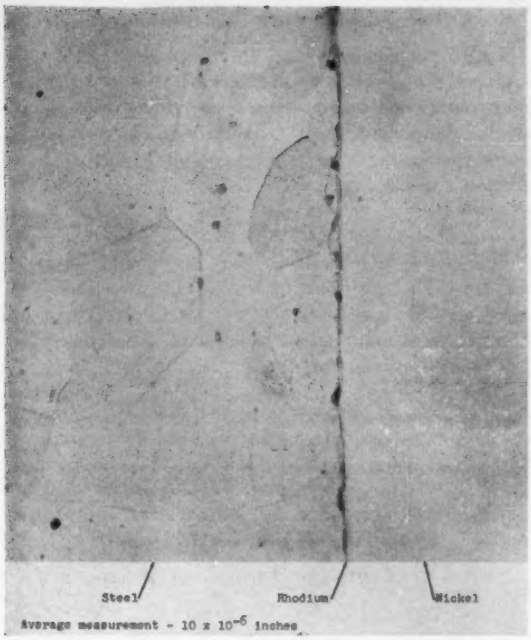


Fig. 2 (X1000)

was made by mounting two samples very close together, depending somewhat on pressure contact. However, this method failed, as the rhodium electroplate peeled away from the nickel when polished. Evidence of this is presented in Fig. 1. This protective film acts as a barrier to keep the metal surface as nearly optically flat with as little rounding of the edges as possible. Care must be exercised in selection of the sample to be measured; it must be cut exactly at right angles to the surface of the sample, making sure all burrs caused by sawing are removed prior to mounting. Mounting in acrylic resin has the advantage of seeing whether the sample is at right angles or not. However, the use of a phenolic resin is preferred, due to its lower melting point, higher hardness, and resistance to attack by acid etchants. Grinding is carried out in the normal manner, usually requiring a series of four water-cooled abrasive papers, followed by use of dry emery papers (3/0 and 4/0). The prepared section should then be lightly etched; this aids in making the boundaries easier to measure.[1] The thickness is then measured directly by the use of a metallograph (1000X).

Relatively close tolerances are reported in thickness measurements ranging down to approximately 0.000008" with the use of the above-outlined procedure. Three samples of electrodeposited rhodium on a flash coat of nickel on steel basis metal were metallographically mounted and examined. The reported thicknesses, calculated on the basis of current density and time, using the efficiency curves for rhodium, as furnished by the solution supplier to the commercial plater was:

Sample No. 1 — 0.000005"
Sample No. 2 — 0.000008"
Sample No. 3 — 0.000015"

The actual thickness of these samples measured metallographically and with an accuracy of ± 0.000002" was:

Sample No. 1 — 0.000010"
Sample No. 2 — 0.000015"
Sample No. 3 — 0.000025"

Figures 2 and 3 show two of the three samples as mounted in epoxy resin with a heavy nickel plate to protect the rhodium.

Cathode Efficiency at Given Current Density

With the high cost of rhodium electroplating, it becomes mandatory for the electroplater to be able to control the deposited thickness during production runs. The method outlined below for determining and, essentially, controlling the rhodium plate thickness gives fairly accurate results, providing the tests are run at close periodic intervals.[7]

This method is based upon the determination of the cathode efficiency of the plating bath at the current density used in production runs. The cathode efficiency on a flat circular test sample would normally have a higher current density on the edges than in the center. On the other hand, if the piece for which the process is being developed is irregular in shape and has sharp corners and localized indentations, the distribution of current density would be considerably different than that of the test piece. Consequently, it is suggested that, if the plating efficiency is measured by differences in weight, these masurements should be taken on a sample similar in size and shape to the production samples. By the use of several strategically placed preweighed (accuracy ±0.1 mg.) discs, preferably nickel or copper, the exact amount of rhodium deposited in a given time can be determined by direct means (weight gain measurements). It is extremely important to maintain the same current density that is normally used in production. Knowing the weight

Fig. 3 (X1000)

of rhodium deposited, the plating bath efficiency may be calculated. This figure in amp./ft.^{2} may be obtained as follows:

$$\text{Actual current in amperes} = \frac{\text{area of work surface (in.}^2\text{)} \times \text{amp./ft.}^2}{144}$$

Knowing the total weight of rhodium deposited, the efficiency is:

$$\text{Plating time (minutes)} = \frac{60 \times \text{wt. rhodium deposit (in grams)}}{\text{bath efficiency} \times 1.28 \times \text{actual amperes}^*}$$

*1.28 is weight of rhodium deposited in one ampere hour at 100% efficiency.

With the bath efficiency now known, the amount of rhodium plated on a production item may be calculated (Using same current density in all operations).

$$\text{Wt. of rhodium plated (in mg.)} = \frac{\text{area (in.}^2\text{)} \times \text{thickness of plate (in.)}}{**0.000005''}$$

**0.000005" is thickness of 1 sq. in. of rhodium surface weighing 1 mg.

This method is based entirely on the plater's adequacy in making frequent checks on the bath efficiency, and making certain the same current density is maintained. This method has found extensive use by many electroplaters as relatively quick, with fairly good accuracy, especially in decorative plating below 0.000008".

Induced Eddy Currents

To the writer's knowledge very little work has been done with eddy currents as a means for measuring thin rhodium electrodeposits. This method of eddy currents has limited possibilities when used directly on the plated piece. In cases where the deposit can be isolated and placed on a glass or other non-metallic surface, the use of eddy current may work. However, rhodium deposits, particularly in the range with which we are concerned, are extremely difficult to handle, the inner stresses making them curl and break.

A means has been developed of using eddy currents for a nondestructive measurement on thin electrodeposits when either the basis metal or the coating is a conductor.[15] Without going into the lengthy discussion on the general properties of eddy currents it has been found that they offer a possibility for measuring film thickness of the following:

1. Conducting films on conductors, through detecting changes in current distribution.

2. Conducting films of non-conductors, by variations in the total amount of eddy-currents in a film thinner than the penetration depth.

3. Non-conducting films on sufficiently thick (more than the penetration depth) conductors, by the increased spacing of the coil from the basis metal.

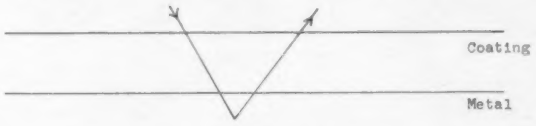
X-Ray Fluorescence - Radioisotopes

X-ray spectrometers and spectrographs, which are equipped for direct measurement of x-ray intensities, have found widespread use in recent years. Equipment of this kind is presently being used to accurately gauge various metal coatings, particularly in the range of flash coatings, such as used in the tin-plate industry. Commercial x-ray units for this purpose are readily available either for single spot measurements or for a continuous indication, as for a tin-plate production line. The desirable feature of the x-ray method is the fact that it is nondestructive in nature. This permits not only a saving in materals, but also yields reliable information on actual production items.

Three variations of this method are available for the measurement of rhodium deposited coatings in our range of interest. These can be best shown schematically below.[8]

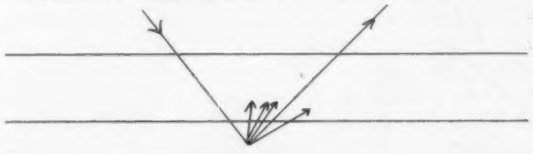
Schematic Diagram of X-Ray Methods for Measuring Rhodium Deposits

Method 1. *Diffraction From Basis Metal —*



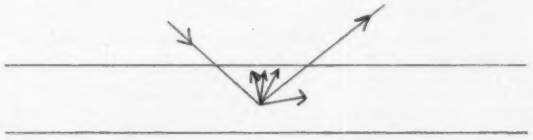
Absorption

Method 2. *Fluorescence From Basis Metal*



Absorption

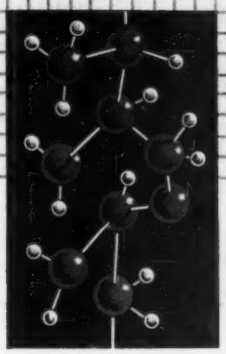
Method 3. *Fluorescence From Coating Metal*



Emission

The diffraction from the basis metal is based on the intensity measurements of a diffraction line of the basis metal. Absorption of the monochromatic beam in its double passage through the plate is a measure of thickness.[12] Diffraction-line intensity is sensitive to many variables which interfere with accurate measurements, such as: grain size, crystal orientation, and state of stress. This difficulty may be overcome in Method 2, which utilizes fluorescent or secondary x-radiation from the basis metal, and is unaffected by the metallurgical state of the metal. This method is most useful in the case of a metal of high atomic number plated upon one of lower atomic number (rhodium has an atomic number of 45 whereas nickel is 28 — nickel is usually the basis metal for rhodium plate), because it is then possible to arrange excitation conditions

(*Continued on page* 56)



SYNTHETIC RESINS

The Backbone of Modern Finishes

A SURVEY OF THE LATEST DEVELOPMENTS IN SYNTHETIC RESINS USED IN COATINGS

Part XI - Alkyds (Section C)

By Harold P. Preuss

THE multiplicity of alkyd resins manufactured by various firms gives some indication of the continued popularity of protective coatings based on these resins. The U. S. Tariff Commission listed the production of alkyd resins made in 1960 for use in protective coatings as follows:

Type of Alkyd	*Dry Basis — Thousands of Lbs.*
Phthalic acid—unmodified	352,207
" " —modified	108,694
Polybasic acid—unmodified	13,251
" " —modified	47,127

Of the polybasic (polyalcoholic) resins manufactured, approximately 60% are based on glycerol, 30% on pentaerythritol and 10% on other polyhydric alcohols, such as the glycols, sorbital, mannitol, etc. Pentaerythritol and sorbitol alkyds are frequently used in the form of mixed esters with glyceryl and glycol alkyds. Pentaerythritol permits the use of longer oil lengths.

In our first alkyd article we discussed briefly the classification of these resins according to oil length. The general properties of the resins which comprise each of the three oil length groups may be briefly described as follows:

Short Oil Alkyds. These are prone to be incompatible in aliphatic solvents and, hence, are normally supplied as solutions in solvents such as xylene or toluene. When modified with oils such as caster or coconut they are used as plasticizers in cellulose nitrate formulations. These short oil alkyds are often also used with melamine or urea resins in formulations for home appliances. Short oil oxidizing alkyds based on soya, dehydrated caster or cottonseed oils are used in many industrial baking enamels.

Medium and Long-oil Alkyds. These are generally soluble in mineral spirits and are frequently modified with oxidizing oils. They are used in brushing-type, air-drying finishes.

Alkyd Resin Modifiers

It is of interest to note that the blend of alkyd with urea or melamine, mentioned above, cures much more rapidly than either resin cured separately. Acid catalysts have a rapid accelerating effect, particularly wth urea resins. Strong mineral acids will effect complete cure even at ambient temperatures. At temperatures over 140°F. alkyd phosphoric esters have a rapid catalytic effect. At temperatures over 212°F. the mild acidity of the resin alone is enough to catalyze the reaction.

Alkyd resins modified by use of linseed, perilla, oiticica, fish or tung oils are fast drying. However, they are apt to yellow. They are usually pigmented with colors and can be used for either baking or air-drying.

Alkyds modified by use of soya, dehydrated caster, sunflower and walnut oils are considered non-yellowing. They can be used to assure good drying and good color retention.

Coconut, caster and cottonseed oil modified alkyds are used for baking finishes. These are the types usually used in combination with urea-formaldehyde or melamine-formaldehyde resins and for air-drying finishes with nitrocellulose.

Rosin is sometimes used to modify alkyds to increase their solubility in aliphatic thinners and to make the resin set faster and harder.

Phenol modification of alkyds increases water resistance and improves gloss. It likewise improves "through dry" by allowing oxygen to act through the film.

Alkyd Wrinkle Finishes

The wrinkle finish has been used extensively in metal decorating for many years. Many alkyd resins find use in the field of wrinkle finishes. This will be noted from the charts accompanying this section as well as previous sections of the Alkyd series. High quality wrinkles are attainable which will bake satis-

PROPERTIES OF ALKYD RESINS
(USED IN METAL FINISHING)

CHART 7

MANUFACTURER	RESIN	% SOLIDS	SOLVENT	COLOR GARDNER 1933	ACID NO.	VISCOSITY GARDNER-HOLDT	POUNDS PER GALLON	% PHTHALIC ANHYDRIDE	% OIL	TYPE OF OIL	PROPERTIES	APPLICATIONS
FREEMAN	CHEMPOL 11-2400	70	MINERAL SPIRITS	(max.) 14	4-7	Z_2-Z_4	7.9	24	64	LINSEED	EXCELLENT WEATHER RESISTANCE LOW COST	MACHINERY ENAMELS
	CHEMPOL 11-2405	60	MINERAL SPIRITS	(max.) 8	4-6	W-Y	7.7	24	64	SOYA FATTY ACIDS	EXCELLENT COLOR RETENTION. RAPID SET AND DRY THROUGH TIME	MARINE FINISHES. RAILWAY FINISHING ENAMELS
	CHEMPOL 11-2406	70	MINERAL SPIRITS	(max.) 8	4-6	Z-Z_2	7.9	24	64	SOYA	EXCELLENT FLEXIBILITY, BRUSHING, FLOW	RAILWAY FINISHES MARINE FINISHES
	CHEMPOL 11-3016	50	MINERAL SPIRITS	(max.) 8	4-6	W-Y	7.6	30	53	SOYA-LINSEED	DURABILITY, GLOSS RETENTION WATER RESISTANT.	AUTOMOTIVE REFINISH ENAMEL; BICYCLE ENAMEL
	CHEMPOL 11-3034	50	MINERAL SPIRITS	(max.) 8	8-11	W-Y	7.5	30	57	SOYA	EXCELLENT EXTERIOR DURABILITY HARDNESS.	AUTOMOTIVE REFINISH ENAMEL; BICYCLE ENAMEL.
	CHEMPOL 11-3212	50	V.M.&P. Naphtha	(max.) 14	3-7	W-Z	7.4	32	52	LINSEED	EXCELLENT WATER RESISTANCE, DURABILITY AND FLOW.	MARINE FINISHES; MACHINERY ENAMELS
	CHEMPOL 11-3214	50	MINERAL SPIRITS	(max.) 14	3-7	W-Z	7.4	32	52	LINSEED	EXCELLENT WATER RESISTANCE DURABILITY AND FLEXIBILITY	INDUSTRIAL PRIMERS MACHINERY ENAMELS
	CHEMPOL 11-3215	50	V.M.&P. Naphtha	(max.) 14	3-7	Z_1-Z_2	7.4	32	52	LINSEED	EXCELLENT WATER RESISTANCE DURABILITY AND FLEXIBILITY	MARINE ENAMELS; MACHINERY FINISHES
	CHEMPOL 11-3218	50	MINERAL SPIRITS	(max.) 14	4-6	Z_2-Z_4	7.5	32	52	LINSEED	EXCELLENT WATER RESISTANCE DURABILITY AND FLEXIBILITY	INDUSTRIAL PRIMERS, MACHINE ENAMELS
	CHEMPOL 11-3310	50	MINERAL SPIRITS	DARK	5-8	Z_1-Z_3	7.5	33	52	LINSEED	LOW COST; GOOD DURABILITY AND FLEXIBILITY	AUTOMOTIVE CHASSIS AND PRIMER ENAMELS; PRIMERS
	CHEMPOL 11-3400	50	MINERAL SPIRITS	(max.) 8	5-8	Z_4-Z_5	7.6	34	53	SOYA-LINSEED	LOW COST; GOOD DURABILITY, GLOSS AND GLOSS RETEN	AUTOMOTIVE PRIMER ENGINE FINISHES; FARM IMPLEMENTS
	CHEMPOL 11-3504	65	XYLOL	(max.) 7	2-4	X-Z	8.5	35	47	CASTOR	TOUGHNESS, ADHESION, GLOSS WEATHER RESIS.	PLASTICIZER FOR LACQUER, UREA MELAMINE ENAMELS
	CHEMPOL 11-3511	50	MINERAL SPIRITS	(max.) 7	4-6	T-V	7.5	35	52	SOYA	EXCELLENT FLEXIBILITY	METAL PRIMERS
	CHEMPOL 11-3514	50	MINERAL SPIRITS	(max.) 8	4-6	Z_4-Z_5	7.6	35	52	SOYA	FAST SET AND DRY. MAX. GLOSS TOUGHNESS, and HARDNESS.	AUTOMOTIVE REFINISH ENAMEL; BICYCLE ENAMEL; METAL SIGNS
	CHEMPOL 11-3515	50	V.M.&P. Naphtha	(max.) 7	4-6	Z_1-Z_2	7.6	35	52	SOYA	FAST SET AND DRY; MAX. GLOSS TOUGHNESS and HARDNESS	FARM IMPLEMENT ENAMELS; METAL PRIMERS.
	CHEMPOL 11-3620	50	MINERAL SPIRITS	(max.) 9	5-9	Z_1-Z_2	7.5	36	52	LINSEED	EXCELLENT WEATHER RESISTANCE, ADHESION, DRY.	AUTOMOTIVE CHASSIS ENAMELS; BUS AND TRAILER ENAMEL
	CHEMPOL 11-3621	50	V.M.&P. Naphtha	(max.) 9	5-9	Z_1-Z_2	7.4	36	52	LINSEED	OUTSTANDING WEATHER RESIS; FLEXIBILITY.	AUTOMOTIVE CHASSIS ENAMELS; METAL PRIMERS; SIGNS
	CHEMPOL 11-3801	50	XYLOL	(max.) 6	2-6	Z_3-Z_5	8.2	38	38	TALL	EXCELLENT COLOR AND GLOSS	LOW COST BAKING ENAMEL
	CHEMPOL 11-4000	50	XYLOL	(max.) 14	4-8	Z-Z_2	7.8	40	44	LINSEED	HIGH RESISTANCE UNDER SALT SPRAY LOW COST BAKING ENAMEL	METAL CABINETS; BICYCLES; PORCH FURNITURE.
	CHEMPOL 11-4006	50	MINERAL SPIRITS AND XYLOL	(max.) 7	5-9	Y-Z	7.8	40	44	COTTON-SEED	EXCELLENT GLOSS, FLEXIBILITY AND AMINE COMPAT.	METAL CABINETS. BAKE PRIMERS
	CHEMPOL 11-4010	50	AROMATIC	(max.) 10	8-10	Z_2-Z_3	7.8	40	48	LINSEED	VERY HARD BUT FLEXIBLE; RAPID SET AND THROUGH DRY	AUTOMOTIVE REFINISH ENAMEL; RAILWAY FINISHES
	CHEMPOL 11-4019	50	MIX	(max.) 10	6-8	Z_2-Z_4	7.8	40	40	TALL	OUTSTANDING COLOR RETENTION	LOW COST BAKING ENAMEL
	CHEMPOL 11-4101	50	XYLOL	(max.) 7	2-6	Z-Z_2	8.3	41	35	COTTON-SEED	EXCELLENT ADHESION TO ALUMINUM	FLUORESCENT LIGHT FIXTURES; APPLIANCE WHITES
	CHEMPOL 11-4151	50	XYLOL	(max.) 7	4-6	Z_1-Z_3	8.2	41	35	SOYA	FAST CURING HARD. HIGH GLOSS	GASOLINE PUMP ENAMELS; RANGE ENAMELS
	CHEMPOL 11-4201	60	XYLOL	(max.) 11	3-6	Z_2-Z_4	8.6	42	32	LINSEED	COLOR AND GLOSS RETENTION	MEETS FED. SPEC. MIL-P-8585A
	CHEMPOL 11-4300	50	XYLOL	(max.) 7	5-7	Z-Z_2	8.2	43	36	DCO	EXCELLENT ADHESION TO ALUMINUM and ZINC	METAL DECORATING FINISHES; WASHING MACHINE ENAMELS
	CHEMPOL 11-4317	50	SC-150	(max.) 7	5-7	Z-Z_2	8.2	43	36	DCO	MAX. ADHESION, GLOSS, FLEXIBILITY, COLOR.	ADVERTISING SIGNS CAN COATINGS
	CHEMPOL 11-4321	60	XYLOL	(max.) 4	1-4	Z_3-Z_5	8.5	43	36	COCONUT	DETERGENT RESISTANCE; GLOSS RETENTION	RANGE AND WASHING MACHINE ENAMELS
	CHEMPOL 11-4402	60	TOLUOL	(max.) 3	6-8	X-Z	8.6	44	SHORT	NON-OXIDIZING	UNUSUAL COLOR HARDNESS AND GLOSS RETENTION	SPACE HEATER ENAMELS

PROPERTIES OF ALKYD RESINS
(USED IN METAL FINISHING)

CHART 8

MANUFACTURER	RESIN	% SOLIDS	SOLVENT	COLOR GARDNER 1933	ACID NO.	VISCOSITY GARDNER-HOLDT	POUNDS PER GALLON	% PHTHALIC ANHYDRIDE	% OIL	TYPE OF OIL	PROPERTIES	APPLICATIONS
FREEMAN (cont)	CHEMPOL 11-4403	60	XYLOL	(max) 3	6-8	X-Z	8.6	44	Short	Non-oxidizing	Unusual hardness, color and gloss retention.	High heat resistant enamels
	CHEMPOL 11-4723	60	XYLOL	(max) 5	5-10	Z_3-Z_5	8.6	47	30	COCONUT	Excellent alkali resistance. Makes fine white baking enamels	Heat resistant enamels. Washing machine finishes
SCHENECTADY	SA-309	50	V.M.&P Naphtha	8-10	4-6	Z-Z_2	75-76	-	30	Linseed	Rapid air dry	Fast air-drying baking and industrial finishes.
	SA-402H	50	XYLOL AND PETROLEUM	3-5	3-5	Z-Z_2	8.0-8.1	-	40	SOYBEAN	Resistant to heat discoloration and yellowing. Durable	Enamels for refrigerators, washing machines, metal cabinets.
	SA-408-X	60	XYLOL	2-3	4-6	Z_2-Z_3	8.6-8.7	-	33	Coconut	OUTSTANDING COLOR RETENTION	USED WITH LACQUER URER AND MELAMINE RESINS FOR HIGH TEMP. BAKING ENAM.
	SA-430	50	SOLVESSO 150	2-4	2-8	T-V	8.0-8.2	-	-	—	HIGH GLOSS; MAR RESISTANT; GOOD FLOW AND LEVELING	METAL DECORATING (general) Cons. Appliances
	SA-604	70	Petroleum Spirits	5-8	4-7	Z_1-Z_3	7.9-8.0	-	60	SOYBEAN	QUICK DRY. GOOD WEAR.	Marine paints
	SA-608R	60	Petroleum Spirits	5-8	4-6	T-V	7.6-7.7	-	64	SOYBEAN	Minimum yellowing. Container stability.	Marine paints
OSBORN	MIRASOL 72	49-51	Mineral Spirits	10-12	4-7	T-V	7.6	-	-	—	Quick drying.	Implements. Agricultural Equipment
	MIRASOL 90	49-51	XYLOL	5-7	4-7	X-Z	8.3	-	-	Linseed	Fast set. Excellent gloss and gloss retention.	Automotive refinishing enamels
	MIRASOL 91-XP-4	39-41	XYLOL	4-5	22-27	Y-Z_1	8.1	-	-	—	Forms tough, abrasion resistant finishes.	Fast setting air-dry or low-bake enamels.
	MIRASOL 95-XP-7	69-71	Mineral spirits	6-8	4-7	X-Z	8.1	—	—	—	Excellent flexibility, good gloss & gloss retention.	Primers for pumps, hoses and machinery.
	MIRASOL S-107	49-51	XYLOL	4-6	3-6	X-Z	8.24	-	-	-	Excellent hardness and mar resistance.	Used where baking finishes of outstanding color & color retention are desired.
	MIRASOL S-108	54-56	MINERAL SPIRITS	(max.) 6	(max.) 7	Z4-Z_6	7.72	—	-	SOYA	Excellent leveling, gloss, color, baking.	Metal decorating where flow, color and gloss retention are important.
	MIRASOL S-111	49-51	XYLOL-75% V.M.P.-25%	5-7	(max) 4-7	Z_1-Z_3	8.0	..	-	SOYA	Blends with nitrocellulose, urea, melamine resins.	White baking urea and melamine enamels.
	MIRASOL S-111-S-100	49-51	SOLVESSO 100	5-7	4-7	Y-Z_1	8.27	—	-	SOYA	Blends with nitrocellulose, urea, melamine resins.	Roll coat enamels
	MIRASOL 123-6-X	59-61	XYLOL	1-3	3-6	Z_3-Z_5	8.57	-	-	COCONUT	Good alkali and acid resistance	Refrigerators, metal cabinets, washing machines.
	MIRASOL 126-6	59-61	XYLOL	4-6	7-12	Z-Z_2	8.3	-	-	—	Durability, flexibility, water resistance.	Used in metal finishes where clean whites and tints are important.
	MIRASOL 127-65-X	64-66	XYLOL	6-8	4-7	X-Z	8.55	36	-	—	With vinylite VAGH produces films with good adhesion, flexibility	Refrigerator enamels.
	MIRASOL 202-A	49-51	COAL TAR and PETROLEUM	9-11	12-18	U-W	7.7	—	-	TUNG	Tough, hard, abrasion resistant films. Salt spray resistant.	Wrinkle finishes
	MIRASOL 205-A	49-51	XYLOL	8-10	4-7	X-Z	8.22	35	-	DEHYDRATED CASTOR OIL	Excellent gloss. Good adhesion.	Industrial primers and enamels. Toy enamels
	MIRASOL 220	49-51	XYLOL & HIGH SOLVENCY NAPHTHA	8-10	18-25	V-X	8.15	—	-	—	TOUGH, DURABLE OUTSTANDING ADHESION AND WATER RESISTANCE	AUTOMOTIVE FINISHES WHERE MINIMUM TIME IS ESSENTIAL
	MIRASOL 222	49-51	MINERAL SPIRITS	9-11	8-12	Y-X	7.5	18	-	LINSEED and TUNG	Excellent water resistance, gloss, color, adhesion.	HIGH GRADE DRUM ENAMELS. PRIMERS ON ALUMINUM
	MIRASOL 305	49-51	XYLOL	7-9	4-7	Y-Z_1	8.5	-	-	—	Tough, high gloss, superior adhesion.	Trucks, automobiles, metal signs, etc.
	MIRASOL 316	49-51	XYLOL	5-7	3-6	Z_2-Z_4	8.36	40	-	DEHYDRATED CASTOR OIL	Hard films; gloss and mar resistant.	White baking enamels where outstanding color retention is important
	MIRASOL 501	49-51	XYLOL	7-9	6-9	R-T	7.88	—	-	—	Excellent solvent resistance and mar-proofness.	Hammer finishes.
	MIRASOL 808	49-51	COAL TAR and PETROLEUM	8-10	12-18	T-V	7.58	-	-	OITICICA OIL	WRINKLES RAPIDLY	Wrinkle finishes.

factorily at 275°-300°F. for 45 minutes to one hour. Temperatures in a convection oven even in excess of 350°F. have been used to bake a wrinkle enamel based on alkyd vehicle with no marked variation in texture.

Manufacturers of Alkyd Resins

This article includes two charts describing the properties of alkyd resins for use on metallic surfaces made by:

Freeman Chemical Corp., Subsidiary of H. H. Robertson Co., Port Washington, Wisconsin
Schenectady Varnish Co., Inc., Schenectady 1, N. Y.
C. J. Osborn Co., 1301 W. Blancke St., Linden, N. J.

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Literature supplied through the courtesy of the firms whose resins are described in this article.

RHODIUM PLATING THICKNESS

(*Continued from page* 52)

so that, essentially, only the basis metal fluoresces. Thus, the intensity, as attenuated by the plating, may be measured without the complication of a monochromator. This method is presently being used in the tin-plate industry. The method outlined by fluorescence from the coating metal is self-explanatory. It requires, in general, the use of a monochromator to sort out the x-rays which originate within the plate and which may be used to measure its thickness.[13] This is an emission method and is well suited for the gauging of thin nickel coatings. Further investigation as to its adaptability to the measurement of thin rhodium deposits is needed before it can be adopted as a referee method.

The investigation carried out by Sellers & Carroll[8] on thin nickel deposits certainly suggests that modern spectrographic instruments may be used for accurate measurement of plating thicknesses in the range up to a few hundred microinches by the use of standards for comparison.

As outlined above, the use of radioisotopes and fluorescence spectroscopy has fairly wide application to the measurement of thin films of many elements. The potential flexibility of the method is partly in the fact that there are three variations of this method as previously stated; use of K x-ray excitation, L x-ray excitation, and absorption of x-rays excited in the basis metal (refer to schematic diagrams). The excitation of fluorescent x-rays by radiation from radioactive sources are analyzed by using the resolving power of a proportional or scintillation counter. The resolution of such a counter is sufficient for distinguishing between x-rays arising from basis metal and thin surface layer, as long as these metals differ by at least two units of atomic number.

It has been reported that radiation from the source (non-destructive test) will be very small and will not be a hazard. The sensitivity of the measurement is limited by the absorption properties of the metal under investigation. It is possible to obtain good results with a thickness much greater than two half-thicknesses of absorption of the fluorescent x-rays in the metal itself. For example, the maximum thickness measurable in aluminum is 4 mg./cm.^{2}, in copper 30 mg./cm.^{2}, and about 100 mg./cm.^{2} for rhodium. This is the range of our measuring interest.

An instrument, presently being marketed, may be used for measuring electrodeposited rhodium, by either measuring the intensity of the fluorescent x-rays from the film or by measuring the intensity from the basis metal which is affected by absorption in the film.

Acknowledgment

Deposit thickness tests were performed by J. Curatolo, Knolls Atomic Power Laboratory, and N. Gendron, M&P Laboratory, both of Schenectady, N. Y.

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Developments In Chromium Plating

By Lester F. Spencer

BASICALLY, chromium plating solutions that are in commercial use consist of an aqueous chromic acid bath to which a suitable catalyst is added. The more widely used catalyst is the sulfate ion, which is introduced into the bath through the addition of sulfuric acid. While chromium may be deposited over a wide range of solution concentrations and operating temperatures, the deposition of an industrially acceptable electroplate dictates that the operating conditions be held to closely defined limits.

The "low concentrate" bath, which has a nominal chromic acid concentration of 250 g./l. and 2.5 g./l. sulfuric acid, is a logical choice where the requirements include a relative high hardness of deposit, high deposition efficiency and a rapid rate of metal deposition. As a result, this bath type is suitable for the production of heavy deposits. The "high concentrate" bath, which has a nominal chromic acid concentration of 400 g./l. and 4.0 g./l. sulfuric acid, is used where higher conductivity plus better covering power on more complex parts is required. In addition, this bath is more tolerant to bath impurities and changes in solution composition, which has made it more popular for decorative plating. According to Logozzo,[1] the intermediate bath type, containing about 300 g./l. of chromic acid, may be adopted as a happy medium on all types of work with the chromic acid-sulfuric acid ratio on a sliding scale of 75 to 1 up to 125 to 1. The lower ratio is preferred by some hard-chromium platers, whereas, the higher ratio has been used by decorative platers for better coverage over nickel in the lower current density areas.

Considerable interest has been expressed in the proprietary, self-regulating, fluosilicate type baths in which the chromic acid-catalyst ratio is automatically controlled. Although a more detailed discussion of these bath types will follow, it may be well to mention a few claims that have been given, thus:— (a) a characteristic high speed of metal deposition; (b) the ability to "chrome onto chrome"; (c) a uniform covering power which is particularly advantageous on complex shapes; (d) an apparent lower adverse effect on the fatigue strength of steel; and, (e) a solution stability under variable operating conditions.

TABLE I

Fluosilicate Bath	CrO_3 — 33 oz./gal. SO_4 — 0.25 oz./gal. Na_2SiF_6 — 1.5 oz./gal.
Fluoride Bath	CrO_3 — 33 oz./gal. SO_4 — 0.33 oz./gal. F — 0.027 oz./gal.
Temperature	110 to 130°F.
Current Density	1.5 to 3.0 amp./in.^{2}

A typical fluosilicate and fluoride type bath are shown in Table I. The sulfate is added as sulfuric acid. The fluoride catalyst is obtained from potassium fluoride, this bath being reputedly one in which some degree of corrosion is possible. To prevent this, it has been suggested[1] to flash chromium plate a part calling for selective hard chromium prior to stopping-off. Then, after the heavy deposit has been obtained, the light protective film of chromium is removed.

Factors Influencing Chromium Deposition

Although extensive investigations have been made by research workers within the field on various aspects of chromium electrodeposition, the mechanism that is involved is still a controversial subject. However, it is not the intent at this time to critically discuss the many hypotheses which have been advanced, but to mention new work that has been performed on the subject.

On one theoretical aspect of chromium deposition, the work of Runkowski & Knoor[3] may be of interest. They measured the deposition potentials at chromium surfaces and have suggested that the deposition of chromium from the hexavalent ion takes place in four steps, the final stage being a reduction of divalent chromium to chromium metal. This was a confirmation of work that had been previously done by Birynknov[4] in 1941 and by Ogburn & Brenner[5] who performed their work in 1949.

It has been established by earlier investigations that the passage of a current through an aqueous chromic acid solution will result in the cathode becoming covered with insoluble chromic chromate, thus preventing the deposition of metallic chromium. As the current density increases to high values, metallic chromium will deposit. However, the deposit will be spongy and produced with poor current efficiency. The reduction mechanism will be considerably different when there is added to the bath a small amount of a foreign anion such as sulfate (SO_4^-), fluoride (F^-) or, fluosilicate (SiF_6^-) ion. These ions are termed "catalysts" since they will permit, under suitable operating conditions, the deposition of metallic chromium without themselves being consumed in the reaction.

The function of a "catalytic" ion has been the subject of considerable speculation; however, it is commonly accepted that some form of a complex is present. Frey & Knoor[6] have suggested that the reason why deposition will not take place from a solution free of catalyst is that a film of trivalent chromium forms over the cathode allowing only hydrogen to be formed. The presence of sulfate ion, as an example,

will enable the penetration of this film and thus permit the deposition of metallic chromium.

Frey[2] has indicated that the sulfate ion, when added gradually to a chromic acid bath, is changed at the cathode during the application of current into a soluble complex compound that can be detected analytically in the bath. The presence of this complex is also indicated by the fact that barium chloride will not precipitate all of the sulfate within the solution.[2,6] Frey has indicated that this complex has linked trivalent chromium and sulfate ions in the ratio of 2:1.

The foreign ion effect in the bath is associated with the free sulfate ions and not with those that form a linked complex. Evidence of this effect can be given by containment of the cathode within a diaphragm — the deposition of chromium ceases after plating satisfactorily for a period of time. It has been suggested that all of the free sulfate within the diaphragm has been complexed and, thus, deposition is inhibited. Without the diaphragm, the sulfate complex which is formed at the cathode is again destroyed at the anode so that, other things being equal, the cathodic chromium deposition can take place for an unlimited period of time.

In order to provide an explanation for the phenomena occurring with reduction, Frey[2] conducted an investigation evaluating the amounts of chromium metal, trivalent chromium, hydrogen, and combined sulfate formed under conditions normal to chromium deposition. He established that the free sulfate concentration falls sharply with time at constant current density. The current yields in metallic chromium and Cr^{+++} likewise fall off, while the yield in hydrogen increases correspondingly. From this study, as well as further electrolyses, in which the starting solutions had a varying sulfate content, Frey found it was possible to ascertain the current yields in metallic chromium in relation to the sulfate content.

It was ascertained that the yield of metallic chromium is at a maximum with a sulfate content of about 1.0 per cent. The current yield in chromium metal decreases with a rising sulfate content above the base concentration of 1.0 per cent; a corresponding increase in Cr^{+++} accompanying this effect. By determination of the combined sulfate in these tests, with the aid of the ratios mentioned of combined Cr^{+++} to combined sulfate in the complex, the free and combined Cr^{+++} could be calculated. It was shown that, with increasing sulfate, the combined Cr^{+++} increases linearly with the free Cr^{+++}.

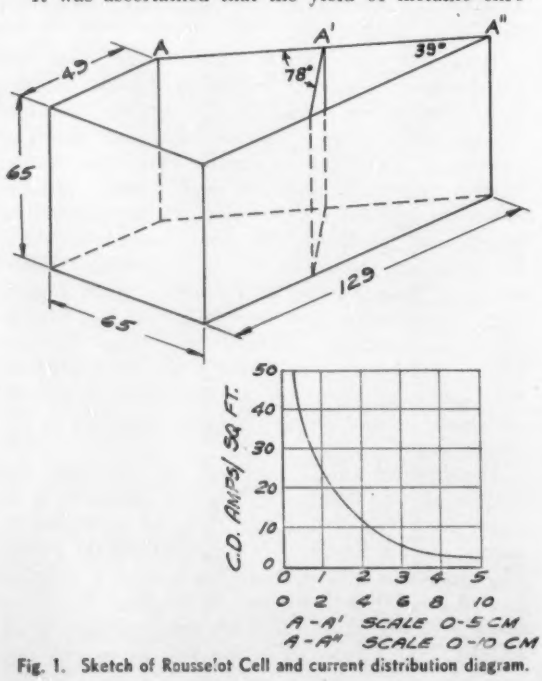

Fig. 1. Sketch of Rousselot Cell and current distribution diagram.

Brittain & Smith[7] performed an interesting experiment in which they continuously observed and photographed at high magnifications the surface of a cathode onto which chromium was being deposited. The work showed that the release of hydrogen bubbles from the surface was a discontinuous process occurring with a definite periodicity. Periodic cracking at the surface of the cathode was observed and was found to be associated with the discontinuous evolution of hydrogen.

On the practical side of the ledger, there are basically five factors that will influence chromium deposition, namely: (a) chromic acid concentration; (b) chromic acid to catalyst ratio; (c) solution temperature; (d) current density; and, (e) concentration of impurities. All of these factors influence the bright plating range and covering power of the bath.

The inter-relationship of the abovementioned factors has aptly been demonstrated by Rousselot,[8] using a standard Hull cell with a specimen bent to an angle of 78 degrees and positioned in the cell as shown in Fig. 1. In his experimentation, the basis of comparison was covering power, which was evaluated by measuring the depth of penetration of the chromium into the bend under controlled plating conditions. He concluded that, at any one temperature and chromic acid concentration, there existed an optimum sulfuric acid concentration to produce the maximum covering power. In the same manner, the effect of impurities such as trivalent chromium and iron on covering power was evaluated.

Not only had Rousselot demonstrated the less critical nature of a "high concentrate" bath to changes of the chromic acid-sulfate ratio and to impurities, but also had proven on a production scale that baths of an intermediate chromic acid concentration were better technically[10] for decorative plating than those conventionally used.

Weimer[9] has mentioned that plating conditions on a production scale are frequently chosen on an empirical basis. Conditions are more easily standardized when relatively simple shapes are to be plated, but more difficult in the plating of a complicated design so frequently realized in the protective plating of zinc die castings. Occasionally, the plating of a complicated design may be simplified by racking and "self robbing" of high current density areas. However, when this cannot be done, it frequently is necessary to obtain a compromise between "What is desired" and "What can be achieved."

The more common catalyst employed in the electrodeposition of chromium is the sulfate ion, which is added at a concentration of about 1.0 per cent by

weight of the chromic acid concentration within the specific bath. This catalyst, along with additions of other radicals such as fluoride, fluosilicate, and fluoborate, are employed in proprietary, self-regulating baths. The advantage of the multiple catalytic addition over a single sulfate catalyst is increased current efficiency.

One of the biggest problems in the operation of a two-catalyst plating bath[9] is the control of the individual catalysts, each requiring separate analysis. Thus, in the standard bath, the two main solution variables would be the chromic acid and sulfate concentrations. In the two-catalyst solution, the variables are increased to three, in which an alteration in the concentration of one means an independent adjustment of the other two. This is further complicated by the fact that fluosilicate or fluoborate cannot be removed readily from the solution in the same way as the sulfate ion by the addition of a barium compound.

In the self-regulating bath, the catalysts are added in the form of sparingly soluble salts, an excess of which is always lying insoluble at the bottom of the plating tank. Alteration in either the solution temperature or the chromic acid concentration within the bath will permit a re-adjustment of the catalyst concentration within the solution as a reversible reaction, in that either precipitation or a dissolving action of residual catalyst will be experienced. This solution equilibrium must be maintained and, to assure that reversibility is active, it is necessary daily to stir up the residue so that it does not become "blanketed" by precipitated lead chromate. The principle of self regulation enables the more exacting dilute chromic acid solution to be used without difficulty.

Invariably, the presence of ions other than the catalysts will adversely affect the deposition characteristics of a chromium-plating solution. Trivalent chromium, when present in amounts above one oz./gal. in a chromium solution, may result in a gray, nodular deposit on heavy buildups. In decorative plating, trivalent chromium is not considered a factor to be reckoned with, since normal operating conditions are in its favor. Thus, since the anode area is always larger than that of the cathode, any trivalency formed at the cathode is re-oxidized at the anode to the hexavalent state because of its larger area. However, in hard chromium plating, particularly where the anode area must be necessarily small to plate internal areas, the normal re-oxidizing process cannot be realized to the fullest extent. In this case, trivalency will build-up, with the result that remedial steps are required to prevent poor work.

Heavy metal impurities, individually and at low concentration, have little detrimental effect, but the additive effects of small concentrations of a number of these metals will certainly reduce covering power. It is thought[9] that this is probably due to the reduction in concentration of "free" chromic acid in which the actual chromic acid to catalyst ration is altered. Iron, which is frequently identified as a contaminant in hard chromium plating, may be tolerated up to about 0.94 oz./gal. without any significant change in plating characteristics. Borates and chlorides are common impurities in decorative chromium plating solutions, the borates being particularly harmful when present in concentrations in excess of a few tenths of an ounce per gallon in fluoride-containing solutions, whereas, chlorides at concentrations as low as 0.007 oz./gal. will be harmful in all types of solution. Chlorides will result in loss of efficiency, reduction in covering power and etching of the bare metal at low current density areas. In hard chromium plating, this impurity will cause an increase in usage of anodes and a nodularity in deposits.

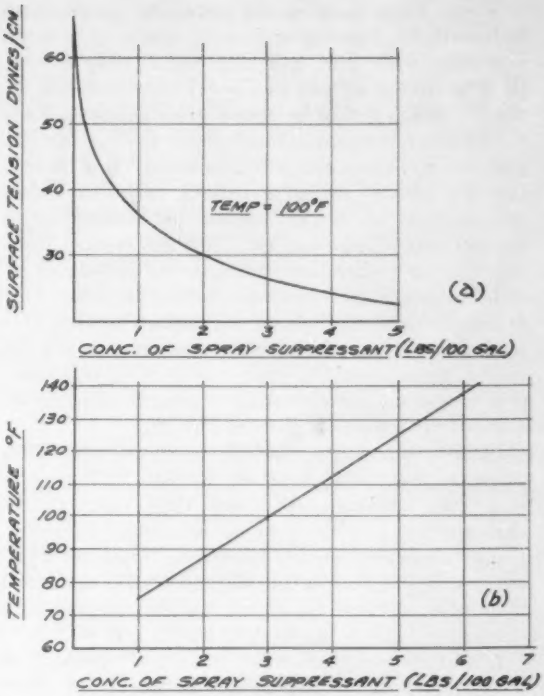

Fig. 2

Spray Suppressants

Due to the low cathode efficiency and high current density characteristics of a chromium plating solution, large volumes of hydrogen are evolved at the cathode during electrolysis, whereas, oxygen is evolved at the anode, due to the use of an insoluble anode. These gases are released in a stream of bubbles of high surface tension and energy and, upon reaching the surface of the bath, they burst violently, throwing out a fine mist or spray of droplets of the highly-corrosive plating solution. This spray represents a definite hazard to the operator due to its highly toxic nature. It also presents a definite hazard to surrounding plating baths, particularly copper, nickel, zinc, and cadmium. Thus, even a small amount of hexavalent chromium as the contaminant may have disastrous effect on both the cathode efficiency and general operating characteristics of the bath. It has been reported[11] that a value on the order of about 0.014 oz./gal. of hexavalent chromium in a Rochelle copper bath will reduce the cathode efficiency to zero. A third factor of importance is the loss of chromium due to misting, which may be as high as 30 per cent of the total chromic acid used.

Although several methods have been employed for the elimination of "misting," each proved to be limited

in scope. These included the use of the paraffin base hydrocarbons, foaming or frothing agents as exemplified by cresylic acid, fish oils, and floating objects. Of more recent interest as a spray suppressant is the use of surface activating agents, these being basically the fluorinated hydrocarbons, which are described in patents[12] and in an article by Ramsden.[11] It is claimed that the surface activating organic performs a dual role in reducing surface tension and serving simultaneously as a foam blanket. They are reputed to be stable at the temperature and under the oxidizing conditions realized in chromium plating. The effect of a fluorinated hydrocarbon on the surface tension of a chromium plating solution with concentration is given in Fig. 2a, whereas, the relationship of the concentration of the surface activating organic to the temperature of the solution is given in Fig. 2b.

These organics are relatively expensive and, when employed for the suppression of mist, it is wise to study the quantities used and their effect on the chromic acid consumption to determine their economic advantage in any particular installation. Of interest is the remark by Weimer,[9] who has stated that these addition agents are not suitable for hard chromium deposits due to their tendency to pit.

It may be well to consider the other methods that have been used in suppressing mist, thus:—

(a) the saturated oils, as exemplified by the paraffin base hydrocarbons, are not totally effective in suppression of mist. In addition, they have several disadvantages which include the possibility of fire hazard, and the carry-over of oil in subsequent rinses, giving rise to contamination and the danger of dermititis, particularly if the oil should become rancid.

(b) Cresylic acid and similar foaming agents are normally readily oxidizable. This fact in itself will infer partial protection of the bath; however, another factor of greater importance must be considered. Thus, there is a danger that this oxidation effect may increase the concentration of trivalent chromium beyond reasonable limits and, thus, cause serious damage to the chromium plating solution.

(c) Although fish oils may be used in smaller quantities than mineral oils, due to their tendency to produce a foam blanket, they are not used extensively due to the necessity of frequent additions to assure complete coverage at all times. Fish oils are considered to be more stable than cresylic acid.

(d) Polyethylene chips, rods, balls and sealed glass cylinders are used to some extent in hard chromium plating where the time factor required for plating is relatively long as compared to decorative plate. The function of these objects is to serve as a floating barrier so as to prevent the spray from reaching the atmosphere. In decorative plating, where the cycle may vary from 3 to 5 minutes, difficulty is experienced in maintaining a proper distribution of these floating objects, and frequently they become entangled with racks and suspension clips, thus being carried out with the articles that have been plated.

Anodes

In contrast to the majority of electroplating solutions, in which metal replacement is from anode dissolution, the complex mechanics of the chromium bath

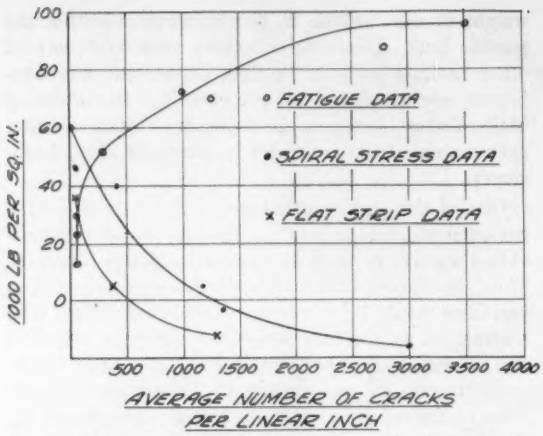

Fig. 3. Relationship between crack pattern and other properties of chromium.

necessitate the use of insoluble anodes. It has been found impractical to use wrought chromium anodes and, as a result, lead or lead alloy anodes are employed universally. During electrolysis, a peroxide film forms on the anode which serves as a protective barrier to solution attack. However, when the chromium bath is idle, this protective film dissolves, which makes it possible for the solution to attack the anode. In order to minimize this attack, a number of lead alloys have been investigated, which include lead-antimony, lead-silver, lead-tellurium and the lead-tin alloys. The 92.0% lead = 8.0% antimony have been found to give satisfactory anode life in the conventional sulfate bath, whereas, 93.0% lead = 7.0% tin is the preferred anode material in fluoride = containing solutions. The lead-antimony-silver alloy is a recently developed anode material which is reputed to be superior[9] to any of the existing lead-base alloys in commercial use. This alloy type is also being considered for tank linings.

The primary function of the anodes in a chromium plating solution is to serve as a current conductor through the solution. To obtain optimum current distribution with attendant good covering and throwing power, it is essential that the anodes not only be correctly positioned but, also, that a uniform film is over the entire surface. This means that daily examination of the anodes should be made to assure that a continuous anode film is present and also to free the surface from salt encrustations. It is also essential that the anode have a sufficient large surface area to permit the re-oxidation of trivalent chromium to the hexavalent state so that a correct balance of about 1 oz./gal. of the trivalent ion is maintained in the bath. Trivalent chromium ion can also be regulated by the current density at the anode, the lower values tending to reduce the formation of trivalent chromium.

It is essential that good contact be maintained at the hooks and between the anode and the hook. The round anode is generally accepted as providing a simple, good performing medium without "blind spots" on the back side. The anode is made from an extruded alloy and burnt into a heavily lead-alloy-covered, short copper hook at an inverted cone joint thus ensuring that it is always above the solution level.

Plating Tanks

A great majority of chromium plating tanks are steel tanks that are lined with a 92.0% lead = 8.0% antimony alloy. Although the lead-tin alloy is used as anode material for the fluoride type solution, its use as tank material is limited, due to a reputed difficulty experienced in producing satisfactory joints. Apparently, antimonial lead lining has given satisfactory service for both the sulfate and the fluoride type solution.

There is some controversy as to procedure employed in conditioning a tank lining prior to its introduction into service. One type of recommendation is that the tank be mantained at a positive potential at all times to ensure that a protective anodic film is always present on the lining. Another school of thought favors a short period of electrolysis of the solution with the tank being made anodic, after which every step is taken to ensure that the tank lining is kept electrically neutral. It is reputed that this latter method has produced very few, if any, lining failures due to electrolytic action.

The use of plastics as a tank material appears to be limited; however, it is anticipated that they will be used to a greater extent in the future. Polyester, resin-bonded glass fiber tanks have been used for the sulfate type chromium plating solutions. Tanks are molded in standard one piece forms with rounded corners and relatively smooth surfaces. Special size tanks are straight-sided and square-cornered, with all joints pressure bonded. Overflow dams and drains can be built in. Wall thicknesses and reinforcement rib dimensions are dependent upon the size of the tank. Vinyl-resin linings also appear to give satisfactory service for chromium plating solutions provided the temperature does not exceed about 140°F.

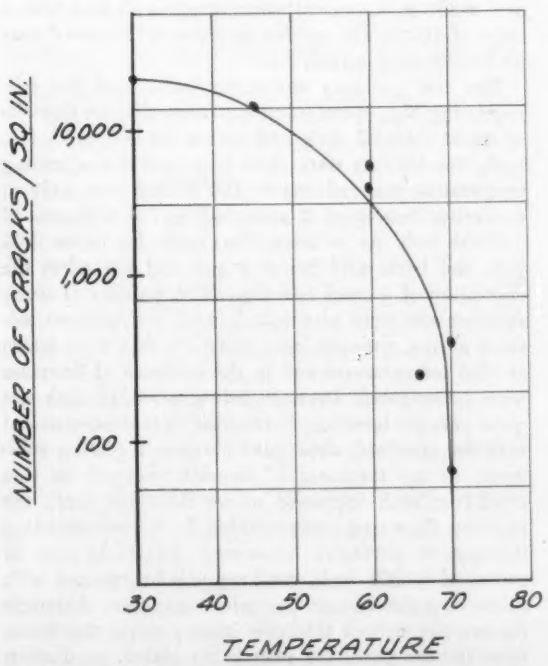

Fig. 4. Relationship of plating temperature on frequency of cracks.

Physical Properties

One of the most widely investigated properties of electrodeposited metals, including chromium plate, is the delayed fracture that may occur in service after a period of time under an essentially constant stress much lower than the yield strength. This phenomenon is particularly evident in the plating of high strength steels and is described as "delayed fracture," "static fatigue," or room temperature "stress rupture." It is also associated with the presence of hydrogen in the deposit, introduced either in the acid dips employed prior to plating, or even in the actual plating operation. One investigator,[13] along with others interested in this field, studied this phenomenon using as a base material A.I.S.I. 4340 steel; which particular alloy has wide acceptance in the aircraft industry. On both specimens that had a direct chromium deposit, and one that had a copper-nickel underplate, the incidence of failure by "static fatigue" was practically nil, indicating that complete recovery was obtained after baking for about 24 hours at 350°F.

Weimer[9] has mentioned the interest in determining the nature of stress within an electrodeposit of chromium and its effect on the fatigue properties of the underlying basis metal. He has indicated that there appeared to be a general agreement that the fatigue limit of chromium plated steel was independent of the hardness of the steel base, but is a function of the residual internal stress of the chromium and the intrinsic fatigue strength of the electrodeposit.

In regard to the effect of chromium plating on the fatigue strength of steel, Williams & Hammond,[20] in an intensive investigation of a Ni-Cr-Mo steel, indicated that: (1) the actual fatigue limit after chromium plating is independent of the hardness of the steel; (2) a linear relationship exists between residual internal stress in the chromium deposit and the percentage loss in fatigue limit; (3) fatigue failure of chromium plated components is governed jointly by the residual internal stress of the chromium and the intrinsic fatigue strength of the electrodeposit; (4) the fatigue limit of normal, hard chromium deposits is about 20 to 25 tons in.^{2}; (5) the fatigue limit of heat treated chromium plated steel varies with the thickness of the chromium deposit, the loss in fatigue strength being greater for thicker deposits. "As plated," the fatigue limit is largely independent of the deposit thickness; (6) heat-treatment in the range of 200 to 300°C. causes further reduction in the fatigue limit below the "as plated" value, but heat treatment at approximately 440°C. restores the fatigue limit to the "as plated" level; (7) by treating at still higher temperatures, e.g. 520°C., it is possible with some steels to restore fully the fatigue limit of the plated steel to a value corresponding to or even exceeding that of the basis material.

Their recommendation for restoration of fatigue strength centers around a reheat; however, their recommended temperature is around 520°C. Some loss in hardness of the chromium deposit will be realized.

Fairly recently, a number of patents had been granted[14-16] which outline a procedure to obtain at least an 85% retention of the fatigue strength of the basis metal. This procedure is based on a plating

sequence from a special bath, followed by a low temperature heat-treatment of the plated article. One patent[14] involves a "high concentrate" bath, comprising 400 to 800 g./l. CrO_3, 0.5 to 6.0 g./l. of a dissolved sulfate, and 0.1 to 16.0 g./l. of a dissolved fluosilicate, the sum of these two catalysts varying with the chromic acid content. The electrodeposit, which is at least 2 mils thick, is heated to a temperature of 200 to 800°F. Another patent[15] involves a "low concentrate" bath containing from 150 to 250 g./l. of chromic acid and a proportionate amount of the double catalysts, the sulfate and fluosilicate ions. This bath is specified to produce a deposit from 5 to 15 mils thick, which has a crack pattern of 1,200 to 10,000 crack-lines per inch. The increase in fatigue strength as the crack pattern increases is illustrated in Fig. 3. It is interesting to note that the patents issued to Stareck and associates claim that a crack pattern of about 1000 crack-lines per linear inch will produce a chromium plated item having a fatigue strength of at least 60.0% of that of the original plated steel,[16] whereas, a crack pattern of 1,200 to 10,000 crack-lines per inch increases this percentage value to 85.0%.

Fry[18] has also made a thorough study of the characteristic crack pattern observed in chromium plated items. He associated parallel striations to the basis metal, as shown by etching a cross-section of a deposit with these cracks, the striations becoming wider and the crack depth increasing with a decrease in the number of cracks as the plating temperature rises. As illustrated in Fig. 4, it appears that these cracks and striations disappear at a temperature of about 160°F.

In uncracked deposits, Fry has indicated that the stress is independent of, or decreases, with deposit thickness. Isolated cracks will be the first to appear and, at the time general cracking occurs, the first striation is formed, accompanied by a decrease in the mean stress. As indicated in Table II, temperature is effective in realizing a heavier crack-free chromium deposit. One comment made by Weimer[9] is that the thickness at which cracking was observed by Fry differs from that normally observed in accelerated or outdoor corrosion tests. There seems to be little doubt among the experts that a corrosive atmosphere initiates cracking where none exists when the metal is deposited.

In a decorative plate, it is well known that a chromium deposit is quite porous up to thicknesses of 0.00002 inch and, when the deposit is heavier than this value, it will crack readily upon outdoor exposure. Under these conditions, one can realize the advantage of a crack-free and pore-free chromium, in that greater service life of a decorative, composite chromium plate will result.

It has been stated that the production of bright, crack-free deposits from conventional solutions is certainly not so difficult as the production of the thicker deposits suitable for engineering purposes. Brown, et. al. produced a bright, crack-free deposit of chromium from a solution having 250 g./l. chromic acid, and a sulfate ratio of 150/200:1. This bath was operated at a temperature of 130°F. and an average current density of 1 amp./in.^{2}. One difficulty is that the conditions

TABLE II

Effect of temperature on maximum chromium thickness which is crack-free (Fry's method)

Temperature, °C	Current Density amp./dm.^{2}	Maximum Thickness for Crack Free Deposits (Microns)	
40	16	> 2.5	< 3.5
	30	> 1.5	<15
50	10	> 1.2	< 2.5
	30	> 3	< 6
	64	> 4	< 8
65	30	>30	
	40	>10	
	64	>14	<24
	80	> 1.5	

of operation of this bath will require considerable modification of existing plant and jigging equipment.

Weimer[9] has suggested a plating solution that could be used with existing plating equipment and yet produced the desired results. The solution has a chromic acid concentration of 375 g./l. and, as with the self-regulating process, the catalysts are in the form of sparingly soluble salts. In this way, with respect to the catalyst, the balance of the solution is self-regulated at varying chromic acid concentrations and at fluctuating temperatures. The recommended operating temperature range was given at 115 to 120°F. and an average current density range of 72 to 288 amp./ft.^{2}. The solution has excellent covering power, and thicknesses of 0.000006 inch per minute can be obtained at 144 amp./ft.^{2}.

A fairly thorough investigation of this bath was made to determine the conditions under which a crack-free deposit was obtained and compared to that obtained from a standard self-regulating bath and from ordinary chromic acid baths containing a 400 g./l. and a 250 g./l. concentration of chromic acid with a ratio of 100:1. The results, as given by Weimer,[9] may be briefly summarized, thus:

The two ordinary chromium baths and the self-regulating high speed solution produced crack deposits at about 0.00002 inch and above. In the crack-free bath, the deposits were crack-free until the operating temperature was reduced to 110°F. and then only at a current density of 2 amp./in.^{2} and a thickness of 0.00004 inch. As to impurities, chlorides below 0.05 g./l. and boric acid below 3 g./l. did not affect the deposition of a crack-free deposit. A number of spray suppressants were also tested, with no apparent adverse effects, although only materials that were stable at high temperatures and in the presence of fluorides were investigated. Deposits below 0.000015 inch are quite porous; however, in contrast to that experienced with the standard, decorative chromium plating solutions, as the thickness of deposit obtained in this crack-free bath increased above 0.000015 inch, the porosity decreased, accompanied by a corresponding increase in corrosion resistance. At thicknesses in excess of 0.0001 inch, cracking will be realized with subsequent decrease in corrosion resistance. Although the average deposit thickness is very much dependent upon the design of the item being plated, production experience has indicated that maximum corrosion re-

sistance is obtained at an averags plate thickness of 0.000035 inch.

A workable high temperature, high ratio, crack-free solution cited[1] contained 375 g./l. chromic acid, 16.5 g./l. sulfuric acid and 33.0 g./l. of trivalent chromium. The operating temperature range is from 125 to 130°F., and the current density 100 to 300 amp./ft.^{2}. This bath may be used where critical metallurgical factors, such as stress, fatigue values, or excessive impact beyond the scope of regular chromium deposits, are required.

It is considered impractical[9] to produce crack-free deposits from conventional solutions unless the operating temperature is above 160°F. A recently patented solution[19] involves the addition of a selenium compound to the conventional chromic acid solution, realizing the deposition of a crack-free deposit up to about 0.001 inch with the bath operating only slightly above 120°F. However, the deposits are dull and the solution has poor covering power, which severely limits its application. A further modification of the basic chromic acid bath has been cited[9] that has adequate plating speed and covering power, although the operating temperature is still rather high (150°F.). This bath is reputed to produce a crack-free deposit up to 0.001 inch in thickness. Since the chloride anion may cause a cracked deposit, this impurity must be kept below 0.03 g./l. The hardness of this deposit is in the vicinity of 600 V.P.N.

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Chromating of Aluminum and Aluminum Assembly

By Robert W. Anderson

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THE treating of aluminum for chromate conversion coatings has long been a problem at many plating shops. The first difficulty encountered is etching of the basis metal. Of prime concern is the pieces that have been machined on which tolerances must be held. The associated problems have been solved by caustic etching the pieces before machining. This removes any preservative coating that has been applied. It also removes the heavy oxide that forms on aluminum and its alloys. The parts may then be machined to their proper dimensions. Because the heavy contaminates have been removed, the material can be processed by a very light etch or, in some cases, by using a non-etch cleaner. Thus, the removal of stock is kept to a minimum on finished parts.

Cleaning procedures vary greatly. One process which has been used successfully on most all types of aluminum alloys is as follows: First, thoroughly degrease all parts. Then proceed to etch or non-etch cleaner (6 to 8 oz./gal.). Rinse in clean running water. Immerse in a bath of straight nitric acid, or a bath consisting of nitric acid 75% by volume (25% by volume of water). Rinse in cold running water. Hot rinse. Immerse in chromate conversion coat for a period of 1 to 3 minutes. Rinse and dry.

The hot rinse before applying the chromate ensures a more even color and coating and works much better than heating the chromate solution itself. Almost the same procedure applies to sheet metal parts that are to be spotwelded or riveted. First, caustic etch pieces prior to assembly. After assembly it is best to avoid caustic and acids if possible. This will avoid entrapment of these solutions in the overlapping areas that have been welded or riveted together, and eliminate bleeding, spotting, streaks, and uneven coatings of chromate.

One means of eliminating caustic and acid is to degrease thoroughly, rinse in methanol (if parts are small), rinse in cold running water, rinse in hot water, apply chromate conversion coat, rinse in cold water, and dry. In the case of large assemblies where it would be impractical to immerse in methanol after degreasing, it is suggested that parts be wiped with methanol or cleaned mechanically, rinsed in clean running water then in hot water, chromated, rinsed, and dried.

If parts must be caustic etched after assembly, it is imperative to rinse parts thoroughly in two running water rinses and a hot rinse before chromating. It is suggested that the parts be rinsed for at least five minutes to ensure relief of trapped cleaning materials, thus eliminating to a great extent white salt formations in joints, caused by cleaner and acid retention. Do not try to over-extend the life of the chromate baths, or to add to a solution. This only leads to a powdery, soft, uneven coating that does not have the desired protective qualities.

Handling Hazards of Organic Finishes

By Dr. D. C. Sayles, *Huntsville, Alabama*

FIRE, explosion or chemical poisoning or toxicity are the three major hazards to which personnel in the organic finishes industry are exposed. In order to prevent the unnecessary occurrences of industrial poisonings or injury stemming from the exposure to toxic or flammable chemicals, a coordinated endeavor involving measures for fire prevention, personnel protection, medical control, engineering control of environmental contaminants, supplemented by health education and supervision, is required.

Potential Hazards

Fire

It is essential that all storage and handling areas for combustible chemicals which are used in the finishes industries be adequately ventilated so that the vapor concentrations are maintained at a safe level. Chemicals which may react with one another must be kept separated. Chemicals should not be stored in quantities which are larger than that which can be adequately controlled by the local firefighting unit were they to catch on fire. Although water is usually the main fire-fighting component, fire-fighting equipment and materials should be specific for the type of fire which may occur. Where flammable vapors may be produced, electrical equipment must be of the explosion-proof type, and the equipment and materials should be adequately grounded. Non-sparking tools should be used, and static-conductive apparel and shoes provided.

Explosion

The principles guiding the elimination and control of fire hazards are applicable to explosion hazards as well. Some thought should be given to the use of earth, sand, concrete or metal barricades in appropriate places to decrease the possibility of the spread of fire or the effects of explosion in the event that these were to occur. These protective devices should be comparable to those employed in the propellant and explosive industries.

Toxicity

The prevention of poisoning and chemical burns of body tissues requires proper engineering design of operations, including adequately designed ventilation; appropriate personal protective practices and equipment; periodic health surveillance procedures; and health education and supervision. Indoors, ventilation is often a matter of major importance; the choice between local exhaust and general ventilation being dictated by the magnitude and the nature of a given operation and the degree of toxicity of the material. Local exhaust ventilation is generally preferred from the health protective standpoint because it functions to control the toxic vapors and fumes at their source.

Maximum Allowable Concentrations

An index of toxicity which is ascribed to chemicals, gases, and vapors is the *Maximum Allowable Concentration* value (MAC). This is expressed as the concentration in air to which a person may be exposed for an eight hour period for indefinite periods without any injurious effects on health. These values (expressed in parts of the chemical per million parts of air) represent a consensus of a group of authorities, and are subject to periodic revision as more exacting knowledge on toxicity is accumulated. By way of illustration, one part per million is approximately equivalent to one pint in three thousand barrels or one inch to sixteen miles. Table 1 gives MAC values for gases and vapors commonly encountered in the finishing industry.

The MAC values cannot be accepted literally without reservation since a great majority of the published MAC values are based on limited experimental data, opinion and speculation. Only in a very few instances has a correlation been established involving humans. Industrial exposure is generally to a mixture of chemical vapors rather than individual compounds and very little is known about the MAC values of chemical mixtures. Further, there is a broad variance in individual sensitivity and susceptibility to toxic chemicals.

The major usefulness of MAC values is to provide a basis for the design of ventilation equipment and systems. It is, however, necessary to fully appreciate the fact that keeping the concentrations of toxic chemicals at or below the MAC values will not necessarily prevent occupational poisoning nor does it mean that concentrations in excess of the MAC values mean inevitable poisoning.

Lethal Dose 50% (LD 50)

A practical measure of toxicity which is commonly used in industrial toxicology is the *LD 50* value. This is the minimum quantity of the poison (expressed in milligrams per kilogram of body weight) which will

TABLE 1

Maximum Allowable Concentrations of Gases and Vapors Encountered in the Finishing Industry

Substance	MAC (ppm in air per 8-hour workday)
Acetic acid	10
Acetone	1000
Acrylonitrile	20
Ammonia	100
Amyl acetate	200
Isoamyl alcohol	100
Aniline	5
Benzene	35
1,3-Butadiene	1000
n-Butanol	100
2-Butanone	250
n-Butyl acetate	200
Butyl cellosolve	200
Carbon dioxide	5000
Carbon disulfide	20
Carbon monoxide	100
Carbon tetrachloride	25
Cellosolve	200
Cellosolve acetate	100
Chloroform	100
Cyclohexane	400
Cyclohexanol	100
Cyclohexanone	100
Dichlorodifluoromethane	1000
1,1-Dichloroethane	100
1,2-Dichloroethane (ethylene dichloride)	100
Dimethylaniline	5
Dimethylsulfate	1
Dioxane	100
Ethyl acetate	400
Ethyl alcohol	1000
Ethyl ether	400
Heptane	500
Hexane	500
Isophorone	25
Methanol	200
Methyl acetate	200
Methyl butanone	100
Methyl cellosolve	25
Methyl cellosolve acetate	25
Methylcyclohexane	500
Methyl isobutyl ketone	100
Monochlorobenzene	75
Naphtha (coal tar)	200
Naphtha (petroleum)	500
Nitrobenzene	1
Nitrogen oxides (other than nitrous oxide)	5
Octane	500
Pentane	1000
Pentanone	200
Isopropyl alcohol	400
Isopropyl ether	500
Propyl acetate	200
Stoddard solvent	500
Styrene monomer	200
Sulfur dioxide	10
1,1,2,2-Tetrachloroethane	5
Tetrachloroethylene	200
Toluene	200
Trichloroethylene	200
Turpentine	100
Vinyl chloride	500
Xylene	200

produce 50% fatalities in a group of experimental animals within forty-eight hours.

Estimating Toxicity from Chemical Structure

Because of the scarcity of toxicological data, a technique for estimating the toxicity of a chemical compound has been devised which is based on the assumption that chemicals having a similar structural configuration will have similar toxicity. This method of determining toxicity by analogy can serve only for providing an indication of toxicity, and should only be used with many reservations. It is only necessary to consider the difference between methyl alcohol (wood alcohol) and ethyl alcohol (grain alcohol) to fully recognize this. While both alcohols are toxic, methyl alcohol is by far the more deadly, and produces rapid poisoning, blindness and death.

First Aid

A well-equipped first aid station should have adequate emergency water avilable in the form of showers, eye bathing fountains, total body immersion tanks and water hoses because water is the most effective single agent for reducing fire, explosion and toxic hazards. After the casualty is drenched with water, dilute vinegar should be applied to neutralize exposure to alkaline chemicals, and aqueous sodium bicarbonate to neutralize contact with acidic chemicals.

First Aid Kits

The first aid kit for use in surface coating installations differs necessarily, from ordinary first aid kits since its contents must be especially suited to effectively treat any injury peculiar to the industry. These kits should be strategically located in easily accessible places in each building, storage area, and close to fire fighting equipment.

The case of the first aid kit should be ruggedly constructed and should have a hinged, tight-fitting cover so as to insure the rigid exclusion of dust. The usual first aid contents, such as, bandages, gauze, compresses, adhesive compresses, adsorbent cotton, adhesive tape, neutralizing solutions, wooden applicators, paper cups, etc. are a must.

The recommended contents for a typical first aid kit in a finishings plant, either of a manufacturing or application type, are:

1. *Equipment*
   - A. Large pair of shears
   - B. Small pair of scissors
   - C. Safety pins
   - D. Paper cups
   - E. Eye cup
   - F. Wooden applicators

2. *Drugs and Chemicals*

A. Sodium Bicarbonate Solution for Eye Treatment

One bottle containing a saturated solution of sodium bicarbonate (baking soda, U.S.P. Grade) and labeled: "For Use in the Treatment of Eye Contamination With Acid." The solution can be prepared by placing somewhat more than ten grams of sodium bicarbonate in a bottle and adding one hundred milliliters of water.

B. Sodium Bicarbonate for Skin Decontamination

Several containers of sodium bicarbonate should be stored in the first aid kid which are labeled: "Dissolve in Water to Produce a Solution for Treatment of Skin Contaminated With Acid."

C. Amyl Nitrite Ampoules as a Stimulant

Several isoamyl nitrite ampoules labeled: "Break and allow the accident Victim to Inhale Contents for 15-30 Seconds, at Intervals of 3 Minutes, so Long as the Victim is Rigid or Unconscious."

D. 5% Acetic Acid Solution

Several bottles of white vinegar, labeled: "For Use in Neutralizing Skin Which Has Been In Contact With Alkali Solutions."

E. Boric Acid Solution

A bottle containing a saturated solution of boric acid (10 grams in 100 cc. of water), labeled: "Irrigate Injured Eyes With Copious Quantities of Contents."

3. *Antiseptics*

The use of one of the more effective antiseptics, such as benzalkonium chloride, etc. is preferred.

4. *Dressings*

Adsorbent cotton (2 ounces)
Adhesive tape (1 inch width)
Adhesive tape (2 inch width)
Adhesive compresses
Band-Aids (an assortment)
Bandage compresses (2 inch width)
Bandage compresses (4 inch width)
Bandage gauze (1 inch width)
Bandage gauze (2 inch width)

5. *First Aid Instruction Chart*

A first aid instruction chart and a list of the contents should be attached to the inside of the cover of the first aid kit. Each item should be clearly labeled as to its contents, and intended use. The kit must be maintained fully equipped at all times, and used items should be replaced promptly.

Color Coding of Hazardous Containers

The inherent hazards in the storage and handling of the solvents in the finishing industry has not always been fully appreciated. The adoption of a color coding system comparable to that set forth in the military standard MIL-STD-172A is advocated, and its adaptation to container color coding would be as follows:

The color coding system should consist of at least two categories to more effectively identify the hazards involved:

1. *Primary Warning Color*: a primary warning color should be the assigned color which identifies the primary hazard from the standpoint of safety considerations.

2. *Secondary Warning Color*: this is the color used to warn of a secondary hazard, and should appear as the second color band on the exterior of the container.

A *yellow* band of color on the container identifies flammable or combustible contents.

A *brown* band of color identifies the contents as toxic or poisonous.

A *blue* band identifies anesthetics or harmful liquids.

A *green* band identifies oxidizing liquids which react explosively or evolve heat when in contact with combustible materials.

A *gray* band identifies liquids which are asphyxiating in confined areas.

The color bands on the containers should extend completely around the container, perpendicular to the longitudinal axis, on the upper portion with no separation between adjacent bands. Band width should be adequate to permit the entire color code to be placed on the upper one-third portion of the container.

Containers

Marking Containers for Shipment and Storage

The identification markings on the containers should be clearly stamped, rollercoated, stencilled, or applied in any practical manner. These markings should not be applied to the bulge of the container since they may become blurred or scratched off during handling.

Handling of Containers

Drums should be handled carefully at all times in order to minimize the inherent hazards of fire, corrosion and toxicity. Rough handling of containers may cause leaks as a result of being dragged, pushed or banged against sharp objects. Sparks may also be generated, and fire could result from a puncture. Mats or wooden platforms are recommended as a means of insuring against spark generation. Drums should be handled by means of hand trucks because rolling the drums, if necessary, must be done slowly and carefully so that minimum agitation of the contents takes place, since non-conductive liquids are likely to build up electrostatic charges, which, unless these are dissipated by grounding, may result in sparks. Sparks in the presence of spilled, leaking or solvent-air mixtures may result in an explosion.

Containers should be preferably handled by means of two-wheel hand trucks or four-wheel hand-operated platform trucks. These should always be fitted with wheels which are made of conductive, non-sparking brass, copper materials, and are of the roller or ball-bearing type which are well packed with lubricant. The platform should be of wood construction with countersunk bolts and fasteners to prevent possible damage to the containers during transport.

The heavy drum cylinders or containers should be handled, for safety reasons, by means of battery-operated trucks of explosion-proof construction. Safe tongs, slings or lifters should be attached securely to

TABLE 2
Disposal of Waste Finishing Materials

Disposal Method	*Material*	*Remarks*
1. Burning	Hydrocarbon solvents Alcohols Esters Ketones Ethers	For maximum safety, these should be ignited by means of a combustible trail.
2. Evaporation	Compressed gases Halogenated solvents	
3. Dilution	Acids Alcohols	These should be diluted to a concentration of about 3-5%, and then poured slowly into flowing water.
4. Neutralization	Acids Alkalies Amines	Before neutralization is undertaken, these materials should be at a sufficiently dilute concentration so that the heat of neutralization is not excessive and can be handled.
5. Dilution and Evaporation	Organic acids	
6. Dilution and Neutralization	Acids Alkalies Amines	

the boom. The container should always be securely tied down so that there is no movement during the period that it is being transferred since it may strike some obstruction.

General rules for Handling Containers:

(1) Leaking drums of flammable liquids must not be handled by storage battery operated trucks until the leak has been satisfactorily sealed, the material removed from the drum exterior, and the contaminated area cleaned up.

(2) Bridge plates between buildings, railroad cars and trucks must be of sufficient strength so as to adequately support the heaviest load which may be transferred over them. They should also be fitted with rims or raised sides to insure that the trucks will not run off their edges. Anchor lugs or angles should be fixed to the underside of the bridges to prevent these from shifting under a load.

(3) If rolling conveyor belts are used for the movement of drums or containers, they must be carefully watched so as to preclude the possibility of having the drums fall off the belt or any other type of mishap.

(4) Containers must be hoisted or lowered carefully, and removed from the hoist in the safest manner possible.

Disposal of Contaminated or Waste Materials

Finishing materials, thinning solvents, etc. which have become contaminated, and constitute a hazard, can be either recovered by redistillation or disposed of by burning, evaporation, dilution or neutralization, or by a combination of these techniques. Table 2 gives specific information as to how this may be done for a number of finishing materials.

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gladly received and the sender's name will be kept confidential, if desired.

Bulk Anodizing

Question: We recently purchased a perforated titanium cylinder to be used for anodizing small aluminum parts. These parts are degreased, etched, deoxidized, and then emptied into the cylinder for anodizing. The solution used is a 15%, air-agitated, sulphuric acid bath with temperature 70 degrees and the voltage 16-18.

So far we have been unable to get a satisfactory anodized surface on the parts. Can small pieces be anodized in bulk or must we rack them? Your opinion would be appreciated.

H. G. S.

Answer: Not all aluminum parts can be basket anodized. The shape must be such that good circulation of solution is possible within the mass or parts in the cylinder.

If you can arrange to pump the sulfuric acid solution through the cylinder, you will probably get better results. However, you must not expect the same quality as would be obtained by racking, in any case.

Determination of Thin Copper Deposits

Question: Could you please advise us on the following finishing problem. A piece of glass is coated with silver and then coated with copper and paint applied. The paint can be removed with caustic. We would like a method to determine the thickness of the copper coating. A drop test or colorimetric method would be of interest. The copper is estimated at 50-100 mg./sq. ft.

S. L.

Answer: The available dropping tests for copper deposits will remove about 5 microinches per second. Since your deposit thickness is only about 3-6 microinches, such tests would be unsuitable.

It is suggested that the copper film be dissolved from a measured area with nitric acid, diluted, neutralized with ammonium hydroxide and the amount of copper determined with a colorimeter or photometer, in the usual way.

Rectifier Ripple

Question: Please advise if an 18% ripple voltage from an unfiltered, 3-phase, half-wave rectifier would cause poor results in bright nickel or chrome plating. The rectifier circuit I refer to is a 3-phase wye. What is the highest acceptable ripple to top grade platers?

W. H. R.

Answer: A three-phase wye rectifier with 18% ripple usually is not considered desirable for bright nickel or chromium plating, although it may work in some instances. There seems to be no general agreement on this subject.

The usual specification calls for a 5% ripple, which will be obtained with a double wye or a full-wave bridge circuit.

White Finishes

Question: Is there any type of white paint that can be applied to lamp shields operating at about 350°F. that will not yellow after prolonged exposure?

T. F. L.

Answer: Finishes based on silicone polymers or copolymers having the proper organic intermediate will remain as white as porcelain. In addition, they possess the properties of hardness, mar resistance, and flexibility. They are useful at temperatures up to 550°F.

Epoxy Coating

Question: Is there any type of organic coating which may be sprayed on rough metal surfaces to provide a sanitary, easily washed, attractive finish?

M. D. A.

Answer: Special spray equipment is available for application of two-component epoxy coatings to rough metal surfaces. The two components are mixed immediately before reaching the surface to which they are being applied. The result is a very smooth, colorful surface. This process is entirely suitable for application to equipment in food processing plants or where a clean, attractive appearance is desirable.

Surface Coating

Question: What type of coating would you suggest for application to metal surfaces exposed to sulfur fumes?

J. R.

Answer: One type of coating that has been used successfully in this application is based on polytetrafluorethylene polymers. A special primer must first be applied and allowed to air dry. Then 4 to 6 coats of the final material, each about 1 mil thick, are applied, allowed to air dry, and then baked at 750°F. until a slight color change in the coating is observed.

Mat Dip for Nickel Plate

Question: I have your latest METAL FINISHING GUIDEBOOK on hand and cannot find any formula for producing a mat finish on nickel plate. Is there a mat dip for this metal?

F. E.

Answer: A mat finish can be produced on nickel plate by immersion in a solution of equal parts of 42° Baume ferric chloride and muriatic acid, at room temperature. It will be necessary to apply a heavy nickel plate to allow for the etching action of the dip.

Catalytic vs. Electroplating

Question: Would you please compare the economics of bulk non-electrolytic plating with the barrel electroplating of zinc or cadmium.

If the non-electrolytic solutions are suitable for the barrel type of deposition, I would like to know if they lend themselves to analysis and correction,

or are they discharged to waste when depleted? Are the techniques primarily the same? What about the overall comparative costs of the deposit compared to barrel electroplating?

M. S.

Answer: In general, electroless plating is more costly than electroplating, and is usually employed where electroplating is unsuitable. Not all metals can be deposited catalytically. Zinc and cadmium are not deposited by this method, so there can be no comparison with electroplating.

Stripping Chromium From Zinc

Question: We have chromium plated a number of zinc engravings with hard chromium to a thickness of about 0.001" and wish to strip the deposit. We have used the reverse current sulfuric acid strip but have been troubled with excessive etching. Can you suggest another, more efficient strip for this combination?

J. B.

Answer: If the sulfuric acid strip is free from chlorides and is maintained at a density of at least 55° Baumé, the attack on the zinc basis metal will be minimized. Better results will be obtained if the deposit is stripped anodically in a chromic acid solution of the same composition as your plating bath. If you have a reverse current etch tank for preparing steel for hard chromium, it will be quite suitable.

Anodizing Aluminum

Question: On aluminum extrusions or sheets that require a high polish prior to anodizing, we are troubled by clouds or the smears that appear on the material after the caustic etch and were wondering if you have overcome this problem with an iron-free tripoli bar or could possibly let us know any hints so as to overcome this problem. Our cycle is:

1. Polish.
2. Degrease.
3. Dip into tank containing 8 oz. /gal. caustic soda solution, 150° F., ½ to 1 minute.
4. Wash and neutralize.
5. Into the sulphuric acid 15% solution.

G. M.

Answer: We doubt whether iron in the tripoli buffing compound is the cause of the streaks. However, you can use an aluminum oxide compound, which will contain no iron.

You do not state what you use for neutralizing. This should be a solution of about 1 volume nitric acid to 2 volumes water, or a deoxidizer of the sulfuric-chromic acid type, which will remove not only iron from the surface but also copper and other metallic smuts, resulting from caustic etching. A non-etching aluminum cleaner should be used if a bright surface is desired.

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Science for Electroplaters

69. Organic Brighteners

By L. Serota

This is the second half of Part 69 of this series. The first half appeared in the November issue.—Ed.

Cobalt-Nickel Bath

L. Weisberg and B. Stoddard found that the presence of sodium formate or formic acid and formaldehyde in a Watts nickel bath containing cobalt sulfate will give a bright deposit of the cobalt-nickel alloy, which requires no buffing or coloring. The deposits, Weisberg notes, are ductile, can be bent or twisted without lifting or peeling, and show little pitting difficulty. Impurities such as lead, copper, iron, zinc, and some organic impurities may render the deposit brittle.

T. P. Hoare indicates that the deposited nickel-cobalt alloy is an example of a bright or nearly-bright bath obtained by co-deposition of a second metal. Metal alloys forming solid solutions over wide ranges, such as nickel-copper, silver-gold, Hoare notes, are not conducive to the formation of bright deposits. A favorable condition for such deposits, it is suggested, would be metals forming complex inter-metallic phases with little or no solid solubility.

The range of bright or semi-bright deposit is governed by the amount of formaldehyde used and the operating conditions of the bath. When a semi-bright deposit is preferred, the amount of formaldehyde used is reduced to less than 0.1 oz./gal., the minimum required for control of pitting, with the bath operated at a pH of about 2.3, 160-170°F., and 40 amp./ft.^{2} or higher, depending upon agitation.

Hoare indicates that formaldehyde belongs to a group of addition agents that produces brightening because of the random manner in which the molecules adsorb and desorb while maintaining a nearly complete equilibrium of an adsorbed monolayer.

To obtain a bright deposit, the amount of formaldehyde is increased to 0.35 oz./gal. and the pH raised to 3.5, with temperature and current density the same as that recommended for semi-bright deposits. Leveling is best attained when the solution is well purified, agitation is employed, and the nickel chloride content is kept below 8 oz./gal. Ammonium chloride must be absent; otherwise leveling will be affected. The quality of the deposit, Weisberg contends, compares favorably with a Watts nickel deposit obtained under corresponding operating conditions.

Brightener Selection

Choice of brighteners entails a consideration of the molecular structure of the compound, with respect to the brightener group and the position of substituent groups in the molecule. The following conditions governing the use of organic addition agents as brighteners are considered important by W. L. Pinner and associates: a sufficiently high solubility to avoid oily effects; avoidance of compounds containing substituent groups which, by reduction or other chemical changes, may affect the brightening action or contribute to resinification. This latter effect interferes with nickel deposition and is referred to as skipping.

E. H. Lyons Jr., in a discussion of clean surfaces, indicates that many effective brighteners are not satisfactory because they materially reduce adhesion by forming an organic (cath-

TABLE 5

CATHODIC REDUCTIONS

Reactant		Reduction Product	
Name	Functional Group	Name	Functional Group
A. Nitrogen Compounds			
1. Nitriles	—C≡N	Imines	—CH=NH
2. Imines	—CH=NH	Amines	—CH_2—NH_2
3. Amides, imides	—CO—NH—	Amines	—CH_2—NH—
4. Ureas; ureides*	—NH—CO—NH	Amines	—NH—CH_2—NH—
5. Thioureas; thioureides	—NH—CS—NH—	Mercaptans	—NH—CH(SH)—NH—
6. Pyrimidines; quinidines; pyrazoles; indazoles		Azines	
7. Azo-compounds	—N=N—	Hydrazo-compounds	—NH—NH—
B. Oxygen Compounds			
1. Acid	—CO—OH	Aldehyde	—CHO
2. Aldehyde	—CHO	Glycol(diol)	—CH(OH)—CH(OH)—
3. Glycol(diol)	—CH(OH)—CH(OH)—	Alcohol	—CH_2OH
4. Ketone	—CO—	Pinacol	—C(OH)—C(OH)—
5. Pinacol	—C(OH)—C(OH)—	Alcohol	—CH(OH)—
6. Ester	—CO—OR	Ether	—CH_2—OR
7. Ether	—CH_2—OR	Alcohols	—CH_2OH + ROH
8. Alcohol	—CH_2—OH	Hydrocarbon	—CH_3
C. Hydrogenation			
1. Acetylenics	—C≡CH	Olefins	—CH=CH_2
2. Olefins	—CH=CH—	Paraffins	—CH_2—CH_2—
3. Unsaturated ketone	—CH=CH—CO—	Saturated ketone	—CH_2—CH_2—CO—
4. Unsaturated amide	—CH=CH—CO—NH—	Saturated amide	—CH_2—CH_2—CO—NH—
5. Aryl ring		Reduced ring*	
6. Acetylenics	—C≡CH	Aldehyde**	—CH_2—CHO
D. Dehalogenation			
1. Trihalo compound	—C—Cl_3	Dihalo compound	—CH—Cl_2
2. Dihalo compound	—CH—Cl_2	Halo compound	—CH_2—Cl
3. Halo compound	—CH_2—Cl	Hydrocarbon	—CH_3
4. Trihalo compound	—C—Cl_3	Unsaturated dihalo	=C—Cl_2
5. Aryl trihalo compound	Ar—C—Cl_3	Unsaturated diaryl compound	Ar—CH=CH—Ar

* R contains no reducible groupings.
** In sulfuric acid solutions, when certain metal catalysts are present.

ode) film between the basis metal and the metal deposit. Filming from brighteners, Lyons adds, in contrast to the general formation of cathode films by adsorption (without the application of potential) requires an electric current at times, in contrast to the general formation of cathode films by adsorption.

Wetting Agents

Surface active (wetting) agents are added to organic bright nickel baths, in addition to the two classes of brighteners, to prevent pitting. Wetting agents attain this effect by reducing the surface tension of the solution, thereby releasing the hydrogen, or air bubbles from the nickel surface before such gases assume pitting size.

Oxidizing agents are not suitable for the prevention of pitting in bright nickel baths because the unsaturated organic addition agents present would be oxidized. Significantly, bright nickel baths containing aldehydes, such as the Weisberg cobalt-nickel bath, exhibit little pitting difficulty and may not require the use of a wetting agent. Other beneficial factors attributed to wetting agents, in addition to lessening pitting, include improved uniformity of the plate; reduced brittleness as well as better leveling and decreased hardness of deposit, especially in baths containing brighteners of the second class.

Sodium lauryl sulfate, $C_{12}H_{25}OSO_3Na$, one of the earliest effective wetting agents, was introduced in 1941 by V. H. Waite, and B. P. Martin. This compound, the sulfate of normal (primary) lauryl alcohol, is representative of a class of compounds (anionic agents) containing 8 to 18 carbon atoms, employed for this purpose.

K. E. Langford used both sodium lauryl sulfate and a condensation product of oleic acid and methyl taurine, 0.4 g./l., because the compounds were chemically unrelated, as wetting agents with brighteners in a nickel bath. More uniform plating and improved covering power were attributed to the reduction of surface tension due to these compounds, rather than to chemical or electrochemical action. A decrease in brittleness of deposit resulted.

Another favorable type of wetting agent, suggested by L. H. Flatt, the alkyl-substituted benzene sulfonates, contain at least 10 carbon atoms in the alkyl chain. Small amounts of the alkyl aromatic sulfonate, it is claimed, eliminate pitting.

H. Brown included in his numerous patents several types of compounds as wetting agents, which he considered unusually satisfactory when used with brighteners containing the radical $-SO_2N$. The following types were indicated: aliphatic monocarboxylic acid esters of aliphatic alcohols containing 8 to 18 carbon atoms, with the sulfocarboxylic acid radical containing 2 to 4 carbon atoms, with sulfoacetates of coconut oil mixed fatty alcohols (mainly lauryl alcohol as an example); sulfuric acid esters or sulfates of polyhydric alcohols such as the sodium salt of monolaurin monosulfate or the lauric acid ester of diethylene glycol sulfoacetate; alkyl ether sulfonates (8 carbon atoms, preferably with alkyl chain of 8 to 18 carbon atoms, such as 1-oxyoctyl-1-sodium sulfonate methane, $CH_3(CH_2)_6CH_2OCH_2SO_3Na$.

Cathode Brightener Reactions

Cathodic reactions, with respect to brighteners, E. B. Saubestre suggests, entails codeposition of brightener, which may involve adsorption deposition of the brightener resulting from cathodic reduction.

H. Brown, in his patented references indicating reduction and hydrogenolysis of the sulfur of the =C—SO— compounds, notes that in this cathodic reaction with the brightener the nickel may act as a catalyst in many cases. The reduction may also produce, in part at least, Brown contends, an inhibitor or poison of the nickel. This latter effect tends to control the rate of reduction and adsorption of brighteners of the second class.

The presence of sulfur in the deposit, as evidence of the reactions indicated, was reported by a number of investigators. For example, A. Brenner and associates found that analysis of bright nickel baths investigated showed the presence of from 0.03 to 0.08 per cent sulfur and 0.02 to 0.06 per cent carbon in the nickel deposits. The sulfur content is considered a contributory factor in the brittleness of the deposit. The sulfur compound formed, Ni_3S_2, Brenner observes, affects the malleability of the metal.

K. E. Langford, in his study of brighteners in nickel plating, found upon analysis 0.16 per cent sulfur in the deposit. The sulfur in the deposit, Langford believes, is derived from the sulfonamide or sulfonimide used, as a result of electrolytic reduction or inclusion, with the latter considered more likely.

Cathode Reductions

Cathodic reduction of (brightener) compounds containing the $=C-SO_2-$ group may occur, Saubestre indicates, in two ways. In one process a stepwise reduction results in the formation of mercaptans (thio-alcohols) =C—SH, while the other process, desulfonation, produces intermetallic compounds, such as Ni_2S_3. A comprehensive listing of cathodic reductions, including the names and functional groups of the reactants and those of the reduction products produced, for nitrogen and oxygen type brighteners, as well as hydrogen and dehalogenation effects upon various types, listed by Saubestre, is shown in Table 5.

A phase in the consideration of brighteners, Saubestre contends, is the complexing (coordinating) character of brighteners as well as the oxidation-reduction products resulting. The following factors are presented in evaluating the effect of brighteners on the properties of nickel deposits: the position of substituent groups and active groups on the molecule with respect to the solubility of the compound; reduction products formed at the cathode; the tendency of the brightener or its reduction products to cause peeling as a result of adsorption on the cathode.

FOREIGN LITERATURE

Practical Applications of the Duplex Nickel Process

B. J. Kuilenberg, *Galvanotechnik*, **52**, No. 7, 388.

The author discusses the development and application of the duplex nickel process, which has now found general application for improving the corrosion behavior of nickel-chromium coatings on zinc die castings. German experience with the duplex nickel process in this application has permitted the conclusion to be drawn that a combined coating can be obtained to show satisfactory performance in the Corrodkote and Kesternich tests.

As a generally acceptable standard for outdoor exposure, minimum copper thicknesses of 7 to 10 microns and a minimum of 20 to 25 microns duplex nickel are used. The processing sequence in the application of duplex nickel is as follows:

1. Precleaning in organic solvents or in emulsion cleaners. Precleaning of zinc die castings is very important to the success of the subsequent plating.

2. Immersion in dilute alkaline solution for 1 to 2 minutes, at a pH of about 9.5 and 60-80°C.

3. Anodic cleaning for 0.5 to 1 minute at 60-80°C., and 5-6 volts. For alloys which contain about 1% copper, an inhibited electrolytic cleaner is very desirable.

4. Rinsing.

5. An acid dip in a 0.5 to 3 per cent by volume hydrofluoric or sulfuric acid with a wetting agent addition.

6. Rinsing.

7. Copper striking in a cyanide copper bath at a low cathode current density for 1 to 3 minutes at 50-60°C. and 6 volts.

8. Bright copper plating in a cyanide bath.

9. Rinsing.

10. Anodic cleaning for 0.5 to 1 minute at 60-80°C. and 5 to 6 volts.

11. Rinsing.

12. Acid dip, usually in sulfuric acid at 0.5 to 3 vol. % concentration.

13. Rinsing.

14. Semi-bright nickel plating.

15. Rinsing (desirable, although not necessary).

16. Bright nickel plating. Minimum coating thickness 5 microns.

17. Rinsing.

18. Chromium plating, preferably from a crack-free bath.

The results obtained in practice have proved to be so satisfactory that, undoubtedly, this process will be used in the future for the improvement of the corrosion resistance of zinc die castings on a greatly increased scale.

Investigations on the Influence of Ultrasonics on Chrome Plating

A. M. Smirnowa and N. T. Kudr-Jawzew: *Zurnal Prikladnoi Chimii* (Russia), **33,** No. 11, 2521.

Ultrasonic techniques have already been employed on a practical scale in electrodeposition. In this report the authors give some details regarding their investigations, which were conducted in the field of chromium plating.

Under normal deposition conditions, it was found that the current efficiency and the quality of the chromium coating were not influenced by the application of ultrasonics. In the range between low current densities and the commencement of chromium separation, the cathodic polarization decreases markedly, but is practically unchanged at higher current densities. The beginning of chromium separation is moved into the range of the higher current densities.

Considerations on the Behavior of Copper, Nickel and Chromium as Electroplated Coatings for Decorative Use

C. Vollers: *Tijdschrift voor Oppervlakte-Technieken* (Holland), **5,** No. 1, 3.

After the various decorative nickel-chrome systems have been discussed, the author draws the following conclusions from Belgian work:

1. Regarded from the corrosion viewpoint, a polished mat nickel shows better behavior than bright nickel with the same coating thickness when both are given a chromium coating 0.25 micron thick.

2. The resistance against atmospheric corrosion can be improved by thicker bright nickel coatings (with bright nickel-chromium systems).

3. Duplex nickel plus 0.25 micron chromium shows the same corrosion resistance as polished mat nickel which has been similarly covered with 0.25 micron of chromium.

4. Chromium coatings which are thicker than normal are found to improve the corrosion resistance of bright nickel.

5. The deposition of crack-free and thick, bright-chromium coatings is not yet possible in the present stage of electroplating practice. As a consequence, the application of bright nickel electroplate must continue in practice, unchanged.

6. Combinations of certain Cu-Ni-Cr systems, at first, show a better corrosion protection. However, at times, they may prove incapable of withstanding sudden, severe demands that may be imposed on them.

Varying Influences and Variable Results with Sub-Coppering for Copper-Nickel-Chromium Plate

E. Roth: *Galvanotechnik,* **52,** No. 7, 381.

The author discusses the changes which occur gradually during plating in the course of large-scale operation, as a result among other things, of the break-down of organic additions present in the bath. These changes occur not only in bright nickel baths but also in bright copper baths.

Details are given by Dr. Roth of his own experiences in connection with sub-coppering from bright, acid copper baths. In many respects, these findings differ from those measured hitherto. In many points, however, an agreement is found.

To investigate the influence of various electrodeposits and combinations, samples of bumper bars in the unprocessed condition were withdrawn from the continuous finishing line of an automobile works and, after plating, were subjected to the Kesternich test. The test conditions were maintained according to DIN 50018 standards. Pretreatment corresponded to the standard procedure, including hot alkaline electrocleaning. A uniform, total coating of about 25 microns on the average was applied. The chromium thickness, in accordance with the more recent conceptions, was applied at the relatively low figure of 0.5 micron. Copper was applied in a proprietary, bright bath.

The test results indicated that, other things being equal, a pore-free copper base coating will provide satisfactory corrosion-resistance. The importance of satisfactory basis-metal surface is indicated. It is easier to ensure a pore-free coating with copper than with a duplex mat nickel-bright nickel combination.

Nickel Anodes

H. A. van Oosterhout: *Tijdschrift voor Oppervlakte-Technieken* (Holland), **5,** No. 1, 23.

A good electroplated nickel coating is obtained not only by good pretreatment and nickel plating methods, but is also dependent to a far-reaching extent on the quality and types of anodes employed. The function of the nickel anodes is not only to conduct the current through the nickel plating bath but their primary and most important function is to maintain the metal content of the nickel bath as constant as possible. A good solubility, accordingly, is important.

Cast, rolled, and electrolytic anodes are on the market. The author discusses the advantages and the disadvantages as well as the particular and most suitable specific fields of application of these various types of anodes. Electrolytic anodes are characterized by a particularly high degree of purity

and dissolved well in the bath. Photos in the text show a depolarized nickel anode of which only a small, residual part has remained, a rolled anode, and an electrolytic anode. In spite of the outstanding solubility characteristics of this last type, it retains an effective surface for a considerably longer period of time.

Corrosion Tests on Nickel-Plated Sheet of Killed and Non-killed Steel

A. Disam, E. Raub and G. Schmidt: *Werkstoffe und Korrosion* (Weinheim, Germany), **11,** No. 9, 554.

The influence of the basis metal on the rust-protection characteristics of electroplated nickel coatings was investigated for various types of steel. No clear-cut difference, with respect to the rust-resistant properties of the nickel coatings, was found with sheets of the various types of steel, all prepared in the same manner for the plating stage by grinding and rubbing-down. The tests comprised the Ferroxyl, salt-spray and humidity tests. Fine differences, which are at times observed during atmospheric corrosion of various types of sheet, could not be established with the short-term tests.

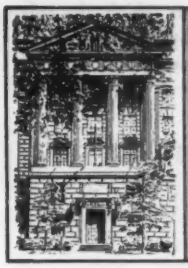
On the basis of the investigations carried out, it was possible to draw the conclusions that, contrary to widely-held opinion, killed steel can be nickel plated and will give the same rust-resistance characteristics as can and does non-killed steel.

Removal of Gases from Electrodeposited Nickel

A. L. Rotinjan and E. S. Ioffe: *Zurnal Prikladnoj Chimii* (Russia), **33,** No. 2, 362.

The gas content of electrodeposited nickel is influenced by the electroplating conditions. Of decisive importance, in particular, is the pH value of the electrolytes, with regard to the extent of the occlusion of hydrogen, oxygen, carbon monoxide, and carbon dioxide.

In their investigations, the authors heated the test parts in vacuum until they were degasified. The degree of degasification depends on the temperature, which was measured during the vacuum treatment. The ratio between carbon and oxygen is also influenced by the content of organic materials in the electrolyte.



Patents

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Electroless Nickel on Magnesium

U. S. Patent 2,993,810. *July* 25, 1961. *D. P. Jensen and L. A. Nelson, assignors to Douglas Aircraft Co., Inc.*

A process comprising: contacting a magnesium-containing body with a chloride ion-free aqueous solution, at 90-95° C., of (1) 10-20 grams per liter of a nickel salt that is free of the chloride-ion; (2) 10-30 grams per liter of a hypophosphite-ion-containing reducing compound that is free of the chloride-ion; (3) 2-10 grams per liter of an inorganic compound that is free of chloride ions and incorporates the radical of hydrofluoric acid as its active factor and establishes fluoride ions in aqueous solution; and adding, in an amount per liter of the aqueous solution adequate to complex the nickel ions in the solution, buffer the body against free hydrogen ions and alkalinize the solution to pH=9-12, a chemical system that is free of the chloride ion and that contain ions which contain the amino group and hydroxyl ions.

Selective Anodizing Aluminum

U. S. Patent 2,993,847. *July* 25, 1961. *J. A. Poch, assignor to Burroughs Corp.*

The method of treating an aluminum object to protect the entire surface against corrosion and render a portion of the surface conductive for an electrical connection, which method comprises first applying a chromate conversion coating to the entire surface of the object to form an electrically conductive mixed metallic oxide surface coating integral with the aluminum surface, said mixed metallic oxide surface coating being formed by contact between the entire surface of the aluminum and an aqueous solution including a hexavalent chromium compound and having a pH of approximately 0.8 to 2, thereafter forming an alkali and acid resist mask on a portion of the electrically conductive metallic oxide surface coating, removing the unmasked mixed metallic oxide surface coating from the aluminum surface by submerging the object in a caustic bath of sodium hydroxide, anodizing the unmasked aluminum surface of the object, and finally removing the mask.

Zinc Plated Steel

U. S. Patent 2,994,126. *Aug.* 1, 1961. *F. J. Kennedy, assignor to H. K. Porter Co., Inc.*

A corrosion resistant surface formed by a coating of zinc which has been applied by electrodepositing an initial layer of the zinc on a ferrous metal from an acid electrolyte and for a thickness of at least 0.00001 inch, and an outer layer of zinc which has been electrodeposited on the initial layer from an alkaline electrolyte to a total thickness of zinc at least 0.0005 inch, and in which the zinc is bonded to the ferrous metal by heat treating of the body after the two layers of zinc have been deposited thereon, to a temperature between 800 and 950°F. to alloy the zinc and ferrous metal but the time of heat treatment being less than that required for the ferrous metal to alloy with the full thickness of the combined layers of the zinc coating.

Ultrasonic Barrel Finisher

U. S. Patent 2,994,165. *Aug.* 1, 1961. *E. L. Brevik, assignor to Purex Corp., Ltd.*

Deburring and burnishing apparatus comprising a tumbling barrel mounted for rotation about an essentially horizontal axis, means connected to said barrel for transmitting rotation thereto, a plurality of separate means for converting ultrasonic electrical energy into ultrasonic mechanical energy mounted approximately equidistant from each other in the horizontal surfaces of said barrel and means for cyclically supplying ultrasonic electrical energy to the single one of said separate means which is nearest the bottom of said barrel during revolution thereof.

Ultrasonic Cleaning Basket

U. S. Patent 2,994,332. *Aug.* 1, 1961. *C. G. Leonhardt, assignor to Acoustica Associates, Inc.*

In cleaning apparatus of the class wherein an upright cylindrical tank has an electro-acoustic transducer secured to the bottom of the tank for vibrating liquid contained in the tank at an ultrasonic frequency, and wherein the articles to be cleaned are placed in a basket for convenience in immersing the dirty articles and subsequently removing the cleaned articles from the tank, the combination with said cylindrical tank of a basket having an imperforate square bottom wall and four rectangular side walls which are imperforate except for a narrow band of drainage holes along the bottom edge of the side walls, said basket being dimensioned to be received in the cylindrical tank.

Electroless Nickel

U. S. Patent 2,994,369. *Aug.* 1, 1961. *W. W. Carlin, assignor to Pittsburgh Plate Glass Co.*

A bath for plating by chemical reduction comprising 1 to 30 grams per liter of a nickel salt, about 8 to 30 grams per liter of a hypophosphite salt, a buffer and 1 to 10 grams per liter of alkali tetraborate.

Gold Firing Paint

U. S. Patent 2,994,614. *Aug.* 1, 1961. *H. M. Fitch, assignor to Engelhard Industries, Inc.*

A gold decorating composition which comprises a gold primary mercaptide and a gold flux.

Electrostatic Spraying

U. S. Patent 2,994,618. *Aug.* 1, 1961. *G. F. Landgraf, assignor to Trion, Inc.*

A method of coating an article comprising moving the article through an electrostatic field extending substantially at right angles to the path of movement of the article, forming a mist of particles of a coating material and maintaining the mist out of contact with the article, supplying a flow of gas separate from the mist forming means to move the mist from the position where it is formed to a position adjacent the article in the first mentioned electrostatic field, electrostatically charging all of the mist particles in an electrostatic field removed from the path of movement of the article, as they move towards the article, and controlling the rate at which the mist moves to the article by regulating only the rate of flow of said gas in accordance with the speed of movement of the article.

Anodizing Process

U. S. Patent 2,995,502. *Aug.* 8, 1961. *E. R. Ramirez and E. F. Barkman, assignors to Reynolds Metals Co.*

Process for the manufacture of anodized aluminum sheet, strip and foil, which comprises treating only the edges and contiguous portions of slit or sheared aluminum in helical coil form having rough edges in a strong acid bath to remove burrs and protuberances from said edges, then anodizing the edges and contiguous portions of said aluminum in coil form to build an oxide coating thereon, the adjacent layers of aluminum in said coil being in substantial contact with each other at said edges and contiguous portions, and thereafter anodizing said aluminum in uncoiled form to establish an oxide coating over the entire surface thereof.

Corrosion Preventive

U. S. Patent 2,995,532. *Aug.* 8, 1961. *T. L. Cantrell, E. E. Fisher and M. L. Hill, assignors to Gulf Oil Corp.*

An improved corrosion preventive composition adapted to form a water-impervious film on metal surfaces consisting essentially of about 2 to about 15 parts of a micro-crystalline wax having a melting point of about 140° to about 170°F.; about 10 to about 50 parts of a metal salt of a thermoplastic fatty acid modified phenol-aldehyde resin and a higher fatty alcohol.

Flexible Polishing Wheel

U. S. Reissue Patent 25,026. *Aug.* 15, 1961. *R. W. Bernstein and A. Block. assignors to Merit Products, Inc.*

A replaceable abrasive unit for cylindrical hub structures having axial slots, a retaining rib at one axial end and flanges at both ends having retaining lips radially outward of the ends of the hub.

Plating Aluminum for Soldering

U. S. Patent 2,995,814. *Aug.* 15, 1961. *H. A. Chamness*

A method of joining two metals at least one of which is aluminum comprising, first immersing said aluminum in a sodium zincate solution for a period between ¼-2 minutes, then removing the deposited zinc film with nitric acid, then immersing again in a sodium zincate solution for a period between 15-30 seconds, then applying a strike coating of copper on said aluminum, next applying approximately .0003 inch of copper by plating in a copper-pyrophosphate bath, next applying another strike coating of copper, then plating silver over the copper plating, then heating said plated aluminum for a period between ¼-1 hour at a temperature of approximately 370°F. and then joining said two metals at their surfaces with a metal alloy in a molten condition.

Vacuum Coating Apparatus

U. S. Patent 2,996,037. *Aug.* 15, 1961. *A. Eng, assignor to National Research Corp.*

A vacuum coating apparatus comprising a vacuum-tight chamber, means for evacuating said chamber to a low pressure on the order of a few microns Hg abs. or less, at least one crucible provided with heating means positioned in said chamber, means for passing a substrate above said crucible whereby vapors emanating from said crucible may impinge upon said substrate, a melting pot located above said crucible, means arranged to permit the passage of solid metal to be melted into the melting pot inside the chamber without substantial admission of gases to the chamber, means for tilting said melting pot, a heated launder located between said melting pot and said crucible, said launder being so positioned as to receive the melt from the melting pot when the melting pot is tipped and being in such position so that when the launder is incrementally rotated the melt will slowly pour from the launder into said crucible and a rotating means provided on said launder capable of rotating the launder at a slow controlled speed whereby it is possible to maintain the level of melt in the crucible at a substantially constant level over extended periods of time while coating is being performed.

Electrostatic Spraying

U. S. Patent 2,996,042. *Aug.* 15, 1961. *J. W. Juvinall, assignor to Ransburg Electro-Coating Corp.*

Apparatus for electrostatically spray coating an article, comprising an atomizer having an annular atomizing edge lying concentrically about an axis of said atomizer.

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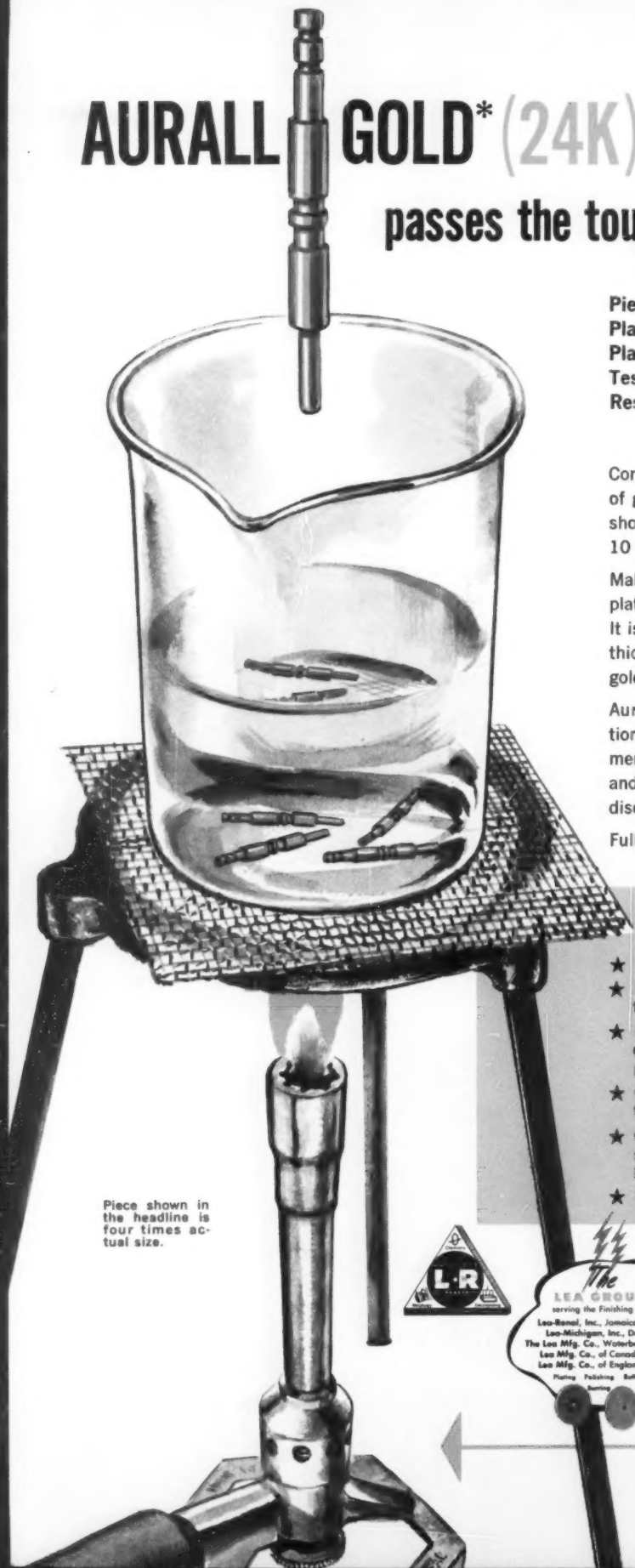

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*Patents pending

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Vacuum Coating

U. S. Patent 2,996,410. *Aug.* 15, 1961. *M. P. Hnilicka, Jr., assignor to National Steel Corp.*

A method for coating a substate in a vacuum coating system which comprises maintaining an atmosphere consisting predominantly of a condensible vapor in an end chamber with at least one passage leading to the atmosphere, maintaining a second chamber at a lower pressure than the end chamber by condensing the majority of the mass of condensible vapors leaking into said second chamber through at least one restricted passage between said end chamber and said second chamber, maintaining a third chamber at a lower pressure than the second chamber, said third chamber being in communication by at least one restricted passage with said second chamber, passing said substrate through said passages and chambers, vacuum coating the substrate while under high vacuum, and maintaining the temperature of the substrate while passing through said chambers above the condensation temperature of the condensible vapor.

Vacuum Coating

U. S. Patent 2,996,412. *Aug.* 15, 1961. *A. Alexander, assignor to Continental Can Co., Inc.*

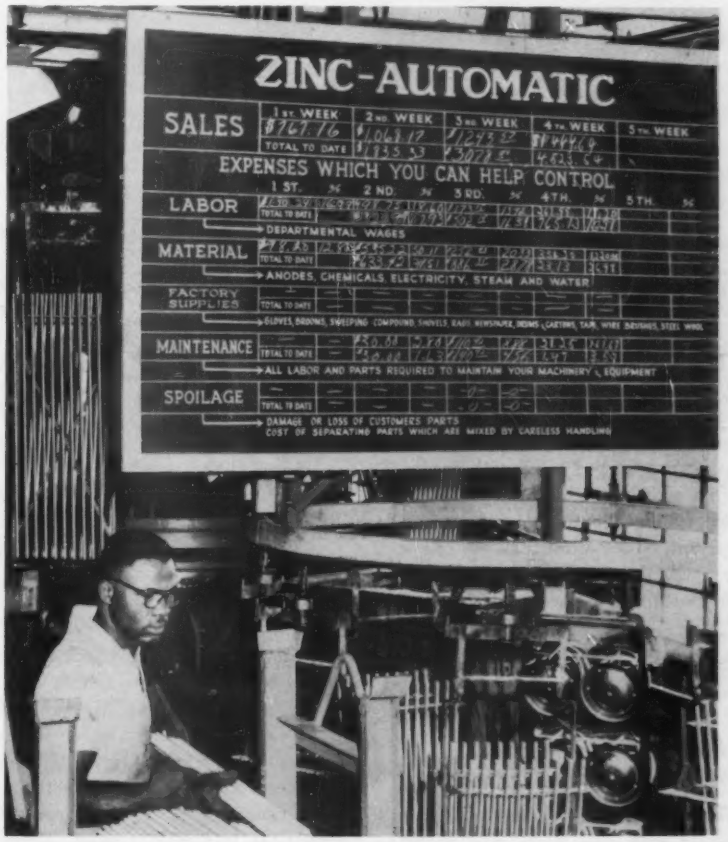
The method of effecting deposition in vacuum of aluminum and like materials having low vapor pressure at elevated temperatures, by exhibiting the same upon a vaporizer element, the invention which comprises heating a part of the top surface of the vaporizer element for a central portion of the width thereof more highly than adjacent side portions thereof whereby to produce temperature gradients with the highly heated portion at a temperature for rapid evaporation of the material and the side portions at temperature below that of substantial evaporation at the prevailing pressure, supplying the material to be deposited to the said highly heated portion of the surface whereby the same is melted, effecting distribution of the melted material as a film over said highly heated central portion of the width of the surface for effecting evaporation thereof from the distributed film whereby the less highly heated side portions restrict creepage of the film toward the side edges of the element, and effecting deposition of the vapor upon the article.

Buffing Machine

U. S. Patent 2,997,815. *Aug.* 29, 1961. *E. J. Guinn, assignor to Lyon, Inc.*

In a finishing machine having a finishing element, the improvement comprising in combination: a fixed base; a workpiece supporting table movably supported directly by said base adjacent to the finishing element; means for driving said table past the finishing element; means for vertically positioning the finishing element with respect to the path of said table; an elongated rail; means securing said rail to said base in spaced relation thereto so that said rail extends along the path of movement of said table; a plurality of switches individually adjustably positioned on said rail; means carried by said table for intermittently engaging said switches as said table moves along said base; and means operated by said switches for controlling both said driving and said vertical positioning means.

Adolph Plating, Inc. Installs Cost Control Boards



Cost control boards placed near plating machinery at *Adolph Plating, Inc.*, Chicago, increases employes' cost consciousness by showing the relation between sales and expenses. Figures on the boards are posted weekly so workers can see the progress they make to reduce controllable expenses. The result is a better understanding of the necessity of cost reduction.

Adolph has placed the boards near the plating lines in their mechanical, semi-automatic, automatic, and hot-tinning departments. Expenses listed are labor, material, factory supplies, maintenance, and spoilage. Company president *Robert L. Giesel* reports. "While the system has not been in use long enough to determine its success in terms of dollars saved, we do know that our people are more conscious of costs and are making a greater effort to control them."

Olive Drab Conversion Coatings

Conversion Chemical Corp., Dept. MF, Rockville, Conn.

A new powder to produce olive drab on zinc die castings, zinc and cadmium plate, Kenvert 11-X is made up at room temperature with water. No other acid addition is necessary. The solution is non-fuming and ventilation is not required. It is self-balancing so that control is no problem, and it is stable so that variation in color of the finished work is not a factor.

The material has been specifically designed for zinc die castings where a heavy duty corrosion protection film may be required as a base for paint. It may also be used on zinc or cadmium plate, and passes the 96 hour salt spray requirement on each. It produces firm wet film strength so that bulk treating is possible.

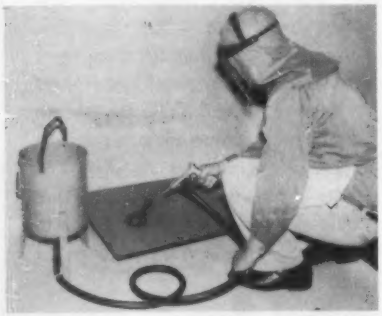
Kenvert No. 11-BE is a powder used in a solution of nitric acid and water at room temperature to produce a hard wet film on cadmium plate. The film has been designed to meet the requirements of color matching Federal Standard #595 Color 34087. The color is constant, the film has good wet strength, the solution does not fume and is stable, it is claimed.

Both products are packaged in 25 lb. and 100 lb. polyethylene drums.

Portable Sand Blaster

Frederic B. Stevens, Inc., Dept. MF, 1800-18th St., Detroit 16, Mich.

This new low-cost sand blaster will operate with any hard, dry abrasive material, and can be attached to existing air sources. No special sand blasting rooms are necessary, as the abrasive blast is confined to a small area. A simple drop cloth placed under the work permits reuse of the abrasive.



The blaster comes complete with pistol-grip type blast gun, extra air jets and nozzles, six feet of sturdy hose (other lengths are optional), and a twelve quart capacity abrasive container. A durable hood and face shield are also included for the safety and comfort of the operator.

Industrial Gold Plating

Lea-Ronal, Inc., Dept. MF, 130-19 180th St., Jamaica, N. Y.

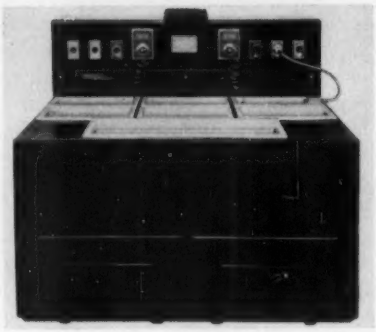
Aurall gold is a pure 24 Karat gold plate without any alloying elements. The deposits are lustrous, show excellent ductility and are remarkably free from porosity. Because of this freedom from porosity, copper and copper alloy parts coated with 50-100 millionths of gold will withstand boiling concentrated nitric acid, it is claimed. Silver or silver plated parts coated with the gold will not be affected by standard hydrogen sulfide tests. On Kovar, deposits will not be discolored at elevated temperatures of 550°C., thus passing the most trying heat tests for the semi-conductor industry.

The new gold bath, which has been completely production tested, in conjunction with several large manufacturers, is a completely stable solution. It combines the advantages of cyanide and acid baths over a wide temperature range, with excellent covering power. It is a mildly acidic solution, simple to operate and easily controlled.

Self-Contained Plating Unit

Davies Supply & Mfg. Co., Dept. MF, 4160 Meramec St., St. Louis 16, Mo.

A self-contained plating console designed for plating printed circuits, and for small cleaning or pickling operations, or bright dipping, is complete in one unit, ready for quick installation, merely by making single water, electrical and drain connections. Its



prefabricated tanks and floor mountings are heavily coated with Davynol plastisol at the factory, where piping and wiring are also built in. No additional equipment or installation is necessary.

The typical console shown in the photo occupies 6 x 4 feet of floor space, with tanks at normal cabinet height. Units are engineered and built to meet the specific requirements of the purchaser.

Low Cost Cleaners

Allied Research Products, Inc., Dept. MF, 4004 E. Monument St., Baltimore 5, Md.

A new line of ARP cleaners is specially formulated for a broad range of uses. The new cleaners include #100, heavy duty soak cleaner and electrocleaner; #105, a general purpose cleaner for soak and electro-cleaning operations; #115, a medium alkalinity soak cleaner; #120, a medium alkalinity high-detergency soak cleaner; #125, a low foaming cleaner for use in automatic power spray cleaning machines; #130, an alkaline de-ruster for ferrous metals.

Plating Barrel Gear

Imperial Industries, Inc., Dept. MF, 36000 Earl St., Wayne, Mich.

Lami-Gear for horizontal plating barrels offers a unique and economical quick repair feature which minimizes production down-time and extends the normal life of plating barrel gears. The gear is precision machined and assembled of four identical gear sections. In the event of tooth breakage,

"By plating this part with LEVELUME 220 we slashed polishing time in half"

says JOSEPH T. HINES, Plant Manager, Southern Finishers, Inc., Nashville, Tenn.

A 50% reduction in the time it takes to polish this griddle cover is only *one* of the reasons Southern Finishers, Inc., is so enthusiastic about Levelume 220. This plater of some 500 different parts has cut polishing time one-quarter in *over-all* operations. Copper plating and copper buffing have been done away with on the griddle part and many others—saving up to two steps in seven.

"Appearance is better, too," says Joe Hines, a plater for 16 years. "Levelume 220 hides scratches nicely, plates brighter in recessed areas than any bath I've ever seen."

Southern is plating parts from ½-inch faucet buttons to 64" x 25" wire racks. What will Levelume 220 do on what *you're* plating? Ask H-VW-M.

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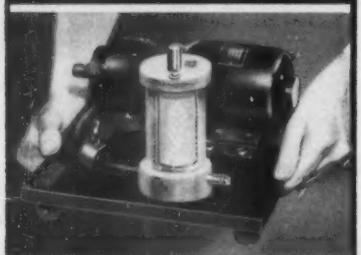

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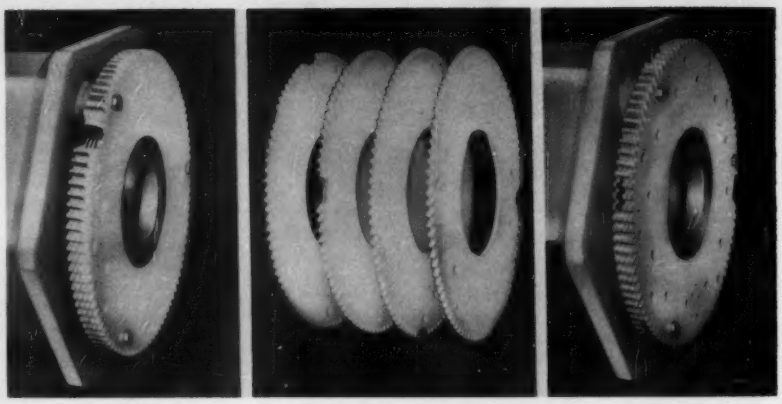


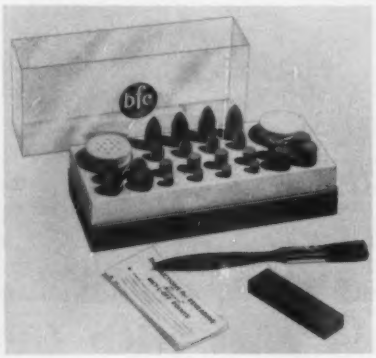
the bolts are removed, the sections are rotated and indexed at 60° intervals and then reassembled to the barrel. Each individual section break is now reinforced by three other sections providing a gear ready for continued operation.

The new gears are made of tough, chemical and heat resistant polypropylene. They can also be supplied in other materials upon request. They are standard on the firm's horizontal plating equipment and are available to fit a wide range of competitive equipment.

Re-Headable Coated Points

Bacon Felt Co., Dept. MF, 11 Fifth St., Taunton, Mass.

New Met-L-Off re-headable abrasive-coated felt bobs for intermediate fine polishing are available in 120, 180, and 240 grits.



The new product offers several major advantages: (1) The felt under the abrasive coating absorbs shock — through its cushioning effect — eliminates chattering and gouging common with solid abrasive media. (2) The points have almost indefinite life because fresh abrasive heads can be applied time after time. (3) The reheading feature also means that surface or rim speed remains virtually constant— an important factor in metal polishing.

The kit, packaged in a convenient bench top box, includes eighteen precoated points, and a supply of adhesive and abrasive for re-heading. The points need only to be rolled successively in adhesive and abrasive to be "new" again.

Ultrasonic Generator

Branson Instruments, Inc., Dept. MF, 40 Brown House Road, Stamford, Conn.

A 400-w ultrasonic generator with special feedback controls for high-speed cleaning automatically compensates for changes in temperature, load, and liquid level. The new Sonomatic A-400 generator always provides full power, thereby assuring maximum cleaning efficiency.

Heart of the new unit is a unique feedback control system. Unlike previous designs, the cleaning medium itself has been included in the feedback loop of the system to make it more sensitive and accurate. Only one simple control is needed for operation at peak efficiency — an on/off switch.

An additional feature of the generator is inclusion of an activity meter, which permits continuous monitoring of the cleaning system. This device instantly indicates the presence of a

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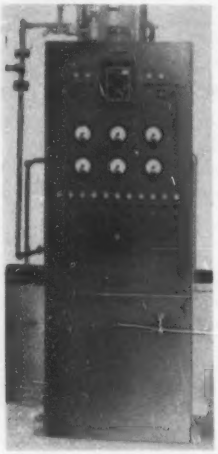
gassy solution, improper cleaning chemicals, too large a workload, or any other situation leading to lower cleaning efficiency.

The generator can be used with immersible or bulkhead transducers as well as tank-type units, either heated or unheated, depending upon the application.

Housed in an aluminum cabinet designed to provide easy access for maintenance, the generator measures 17 x 15 x 9 in. deep. Use of heavy-duty components assures long life and trouble-free service.

Automatic Demineralizer Control

Barnstead Still and Sterilizer Co., Dept. MF, 307 Lanesville Terrace, Boston 31, Mass.



The above manufacturer announces the development of automatic starting, stopping, and regenerating controls for its line of mixed-bed, two-bed, and four-bed demineralizers in capacities up to 2,500 gallons per hour.

These controls provide: (1) automatic regeneration of ion-exchange resins when they become exhausted. The automatic regeneration includes automatic back-wash, regeneration with acid and caustic solutions, and rinsing of the resin beds. When regeneration is completed, the equipment returns to service automatically. The timing of each step in the regeneration procedure is individually adjustable to meet specific conditions and all valves have optional manual operation.

In addition to automatic regeneration, the controls provide: (2) purity safeguards for continuous testing of the demineralized water being produced. Water of sub-standard purity is automatically diverted to waste until the condition upsetting pre-set purity has been corrected; (3) a full tank of demineralized water is maintained automatically with a Level Monitor device activating the equipment when water level in storage tank gets to below a pre-set level.

Buffing Compound Remover

Enthone, Inc., Dept. MF, 442 Elm St., New Haven 8, Conn.

Enthol V-240 is unlike ordinary emulsion cleaners in that it will invert at operating temperatures to a water-in-oil emulsion. This enables the heavily soiled work to be acted upon by 100% hot solvent; the most tenacious soils are rapidly penetrated. Upon removal of the work from the operating solution, the entrained emulsion reverts to an oil-in-water form and can be readily rinsed off.

The material is used at 5-10% by volume in water at 180-200°F., if the invert qualities of this cleaner are desired. Immersion times of 2-10 minutes are usually sufficient. When the work is removed from the bath and allowed to cool to 150°F., the emulsion reverts to an oil-in-water form and is easily rinsed off in a subsequent cold water rinse.

The solution is intended as a pre-cleaner prior to pre-plating cycle for removal of buffing and polishing compounds, oil, grease, drawing compounds, and grinding lubricants. It removes soils from steel, aluminum, copper, zinc die castings, and most other metals without reacting on the basis metal.

The solution is non-flammable and has extremely long life. Upon cooling, accumulated soils rise to the surface and are readily skimmed off. With the use of a simple analytical control procedure, the operating solution may be periodically replenished to ensure a long and productive life. A product with many uses, it is primarily used as a soak cleaner but it is also very effective in pressure spray equipment for the initial removal of buffing compound deposits. Additionally, this product may be added to alkaline cleaners to improve their cleaning action on certain types of soils.

Blackening Process for Steel

Du-Lite Chemical Corp., Dept. MF, 12 River Road, Middletown, Conn.

Orthox is a completely new blackening process for steel which is said to produce a hard, dry, corrosion-resistant, deep black finish. A low temperature process that rinses free in cold water, it revealed no rust or corrosion after 180 hours in standard humidity tests, without additional coatings, it is claimed, and standard salt spray tests showed no rust on parts after 1½ hours. Steel parts blackened by the process can be stored in a dry state for many months without rusting. The blackening salts also contain ingredients proportionally balanced to rectify contamination that might otherwise be visible in the bath.

The product is a fluid solution and, due to its extreme solubility, less drag out of materials takes place. It provides a particularly attractive black finish that exceeds Government Specification MIL-C-13924 A.

Rinse Aid

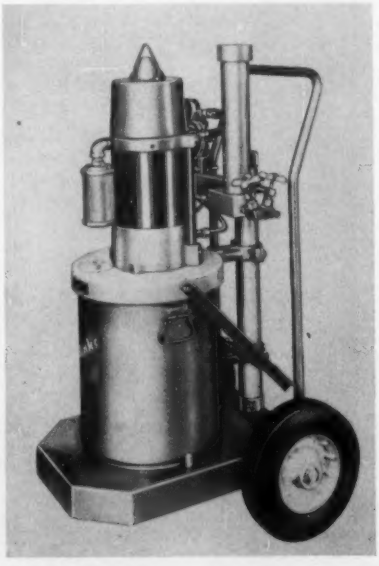
Frederick Gumm Chem. Co., Inc., Dept. MF, 538 Forest St., Kearny, N. J.

Clepo Rinsade A is a liquid additive for use in water rinse tanks. It aids in removing water and, as a result, eliminates drying stains and minimizes "spotting out." When used on otherwise untreated steel, it provides a film which has mild rust inhibiting action, it is claimed.

Airless Spray Unit

Binks Mfg. Co., Dept. MF, 3140 Carroll Ave., Chicago 12, Ill.

A new airless spray unit, designed for high volume, multiple gun operation, the "Titan" features a 21 to 1 pumping ratio, will pump 3 GPM under continuous duty conditions, and is available in two models. One model is a 10 gallon portable unit designed for on-site multiple gun operation, mounted on a roll-around cart. The other model is designed to pump direct from 55 gallon original material containers. The basic pumping unit is similar to the portable model, and both will



handle the large orifice tips necessary to apply thick coatings.

Specifications for both models include: double acting 5-inch stroke, 6-inch diameter air motor with twin spool air valve, fluid displacement of 3.75 ounces per stroke at 34 strokes per gallon, air consumption of 10 to 40 CFM. Both models also have a ball fluid valve with removable seats that are reversible for maximum service life. Both are equipped with pump elevator and material agitator.

Plastic-Clad Pipe and Fittings

Polymer Corp., Dept. MF, 2120 Fairmont Ave., Reading, Pa.

Polypenco pipe and fittings provide complete inside-outside protection with a coating of Penton chlorinated polyether, a chemically inert thermoplastic, from low temperatures to 250°F. and above. The claddings also have outstanding mechanical stability and wear resistance, it is claimed, and are applied in the patented Whirlclad fluidized bed coating system.

Claimed to have selective cost and performance advantages over other high order corrosion piping, the clad pipe is more easily assembled than separately lined pipe and eliminates liner adhesion problems. The exterior cladding applied simultaneously with the interior during the coating operation eliminates need for separate outside corrosion protection.

The new pipe is available in standard 10-ft. lengths in 1½" through 24" diameters, Schedule 40 wall thickness, clad inside and outside with a 0.25"-.035" protective film. A complete line of elbows, tees, crosses, reducers and laterals are available for these sizes. Other wall thicknesses and diameters can be produced on request.

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Paint Pretreatment

Industrial Finishes Co., Inc., Dept. MF, 2 Bryn Mawr Ave., Bryn Mawr, Pa.

A new product for the pre-treatment of steel and other ferrous metals to insure more effective protective coatings, Ifco #101 is a rust remover and neutralizer, it is claimed. The treatment lasts weeks or even months and the coatings need not be applied immediately after pre-treatment. Upon maturity, it reacts with a metallic surface to form a non-crystalline complex metallic phosphate film and it provides a continuing protection and serves as an excellent case for paint and coating application.

Phosphating Primer

Industrial Metal Protectives, Inc., Dept. MF, 401 Homestead Ave., Dayton 8, Ohio.

Zincilate RCP rust converting primer, applied by brush or spray to any rusted ferrous metal or galvanize, penetrates to the basis metal and lays down an iron phosphate coating, it is claimed. Rust is actually converted into iron phosphate, and the product creates a moisture-proof primer that effectively prevents future rusting. The primer coat will accept a decorative topcoat two hours after application, without any further preparation.

The primer is being offered as a clear coating and is also available in standard primer colors.

ARMORETTE COATING USED BY BECKMAN INSTRUMENTS ON COMPUTERS, TEST EQUIPMENT

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A textured vinyl finish applied at low baking temperatures, ARMORETTE is used on a number of Beckman's computers and electronic test instruments. Another leading ARMORETTE application: garnish moldings of the Chrysler Imperial

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- Three times more abrasion resistant than gloss or semi-gloss enamels and of comparable cost.
- Can be used on a broad range of dissimilar materials including steel, aluminum, wood, reinforced polyester and pressed wood.
- Remarkable ability to cover surface imperfections.
- A wide selection of gloss and colors, including both metallic and non-metallic.
- Excellent salt spray, humidity, chemical and scuff resistance.

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Zinc & Steel Barrel Cleaner

Patclin Chemical Co., Inc., Dept. MF, 11-23 Casimir Ave., Yonkers, N. Y.

A new, heavy-duty barrel cleaner for the cleaning and brightening of zinc and steel prior to plating, #336 is based on the newer concepts of chelation and inhibition. It is a highly alkaline blend of alkaline salts, sequestering and chelating agents, colloidal dispersants, and surfactants.

The material exerts a trifold action upon zinc. It cleans, removes the oxide surface skin, and brightens zinc to an almost burnished finish in a short period of time, and at a low concentration, it is claimed.

The product can also be used for the cleaning of brass and copper bearing alloys without causing any darkening or discolorations upon the metal. It is shipped in 450 lb. steel drums.

Plastic Disposable Glove

Wilson Rubber Co., Dept. MF, Industrial Div., 1200 Garfield Ave., S.W., Canton 6, Ohio.

Wil-Gard Poly-D is an improved disposable glove made of "soft-formulation" polyethylene plastic. Its polyethylene formula gives the new glove extra toughness, touch sensitivity, and comfort. Heat bonded seams are strong and smooth, so that there is no irritation, and the plastic has more flexibility than standard polyethylene.

Completely moisture-proof, the new

disposable glove provides excellent hand protection against scores of chemicals, powders and resins, and safeguards precision parts against perspiration corrosion.

Each glove is lightly mounted on paper and packaged 72 to a box in convenient wall-dispenser cartons. Also in 1,000 unit bulk packaging. The same glove fits either hand.

Caustic Black for Steel

Tivian Laboratories, Dept. MF, P.O. Box 2311, Providence, R. I.

"Black Widow No. 6" is a new low temperature blackening process tailored for low carbon steel. The chief advantage of this bath is its operating range — it will give a uniform black oxide coating over a temperature range of 15°C. without blue or red effects, it is claimed. The recommended operating range for the bath is 120-135°C. (248-275°F.).

The material is provided as a concentrate, which is diluted 4:1 with 50% caustic soda solution. Thus 10 gallons will make 50 gallons of solution. The customer may mix his own 50% caustic soda solution or buy it premixed. Upon special request a special solution with caustic already added can be supplied.

Plastic Masking Material

Evens-Thompson Mfg. Co., Inc., Dept. MF, 11360 Kaltz Ave., Center Line, Mich.

A new, easy handling, quick-dip material that is reusable as many as six times, is a specially developed, cellulose acetate butyrate plastic, and is available in two grades — Dip 'n Strip Mask 4, for general use, with a 350° to 360°F. dip temperature, and

Dip 'n Strip Mask 3E, for use in high temperature or rough acid baths, dip temperature approximately 370°F. Both grades are available in blocks cut into usable pieces, ready for use in a regular thermostatically controlled electric pot.

The material is non-toxic, safe, and easily used by the average worker. It is unusually tough, flexible, and resistant to rough handling. It does not crack, craze, cobweb, or divert electrical current. A quick dip affords a tough 0.050" coating, which sets up in 30 seconds or can be quenched in water for instantaneous setting. The material is easily and accurately trimmed with a sharp knife, and strips cleanly in one piece, after use, for return to the melting pot.

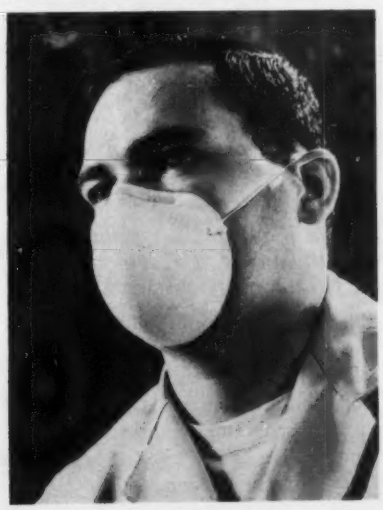
The material does not fuse to the coated part, yet permits no undercreepage as it tightens when it sets, it is claimed. It contains no fillers or solvents, so fire hazard is non-existent at normal operating temperatures and shrinkage is very minimal.

Filter Mask

Minnesota Mining and Mfg. Co., Dept. MF, 900 Bush Ave., St. Paul 6, Minn.

A new featherweight filter mask that combines high filtration and comfort is designed for maximum filtration of non-toxic dust and sprays.

"3M" brand filter masks No. 8200 are made of a non-woven fabric. They provide 3 to 5 times more filter area than other masks because they are all filter and are shaped to stay away from the nose and mouth. An elastic headband seals the single-unit mask around the edges and a flexible metal nosepiece adjusts to fingertip pressure. The mask conforms to any face and allows easy breathing, unmuffled conversation and unobstructed vision.



Nine masks weigh less than one ounce. The cool, dry masks are reusable, yet inexpensive enough to discard after a single wearing. Masks are packaged 50 to a box and are available at industrial distributors.

Micro-Porous Filters

Selas Flotronics, Dept. MF, Spring House, Pa.

A new line of micro-porous industrial filters features positive sealing which permits absolute retention of particles in sizes down to 0.3 micron. In-line mounting, with the filtering element attached separately to the mounting head, permits the case to be removed without breaking line connections or disturbing the element. A sleeve on the filter element fits over an O-ring on the mounting stud to ensure micro-tightness. The only flow in and out of the filter is through the microporous elements.

Filter elements are being offered in seven grades of micro-porous porcelain, seven grades of micro-porous stainless steel, eight grades of microfine stainless steel screens and four grades of bonded glass fiber. Cases of carbon steel, stainless steel and nickel-plated brass are offered with inlet connections of ⅜, ½, ¾ or 1-inch. All elements are interchangeable and all cases including those of brass can be used with system pressures to 250 psi.

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Manufacturers' Literature

Gold Alloy Baths

Technic, Inc., Dept. MF, P.O. Box 965, Providence, R. I.

A new instructional booklet gives full information on equipment, preparation procedures, formulas, operation data, and replenishment needs of gold-antimony, antimony gold (barrel plating), gold-indium, and gold-gallium alloy baths.

Emulsion Cleaner

MacDermid Inc., Dept. MF, Waterbury 20, Conn.

A new emulsion cleaner, M-624, designed to remove hard impacted buffing compounds from all types of basis metals is fully described in Technical Data Sheet No. 39.

Spray-Applied Plastisol

Metal & Thermit Corporation, Coatings Sales Office, Dept. MF, Carteret, N. J.

A new four-page brochure, Bulletin SP-1, on spray-applied, thick layer, Unichrome Super 5300 plastisol describes the features of the improved vinyl plastisol.

Urethane Coatings

Better Finishes & Coatings, Inc., Dept. MF, 268 Doremus Ave., Newark 5, N. J.

A new brochure shows why BFC urethane coatings provide marked superiority in resistance against chemicals, corrosion, abrasion, weather and wear as compared with other widely-used types of coatings.

The chemical reaction by which the coatings cure to a tough, cross-linked resilient film is clearly explained. A comprehensive table lists the chemical resistance of cured films to 55 chemicals. Typical uses are listed and illustrated.

Belt Polishers

Hammond Machinery Builders, Inc., Dept. MF, 1601 Douglas Ave., Kalamazoo, Mich.

Abrasive belt grinders, and their wide application on grinding, polishing, buffing, and deburring operations such as internal, flexible belt, platen, contour, and contact wheel, are the subjects of a new catalog, ABG-300.

In addition to providing comprehensive data on the use of abrasive belt machines, the new 20-page catalog contains specifications, photographs, and cutaway drawings illustrating the construction and design features of each grinder. Also described in detail are the construction features and the exclusive advantages of the firm's line of general purpose grinders, carbide tool grinders, and polishing lathes up to 3 HP.

Hydroxyacetic Acid

E. I. duPont de Nemours & Co., Inc., Public Relations Dept., Wilmington 98, Del.

A technical bulletin on hydroxyacetic (glycolic) acid describes its use in cleaning, plating, electropolishing, pickling and other processes.

Rust and Scale Remover

Diversey Corp., Dept. MF, 212 W. Monroe St., Chicago 6, Ill.

A new bulletin describes Everite, a fast-acting rust and scale remover.

Non-Foaming Cleaners

MacDermid Inc., Dept. MF, Waterbury 20, Conn.

A complete line of non-foaming cleaners designed for use in power spray washing machines is fully described in Technical Data Sheet No. 7. A chart enclosed with the technical data enables the operator to select the best of several spray cleaners to suit a particular job, taking into consideration the basis metal, type of soil, water, factors such as time, temperature and pressure, and the relation of the cleaning cycle to other metal finishing operations.

Rotary Air Pumps

Leiman Bros., Inc., Dept. MF, 102 Christie St., Newark 5, N. J.

Six-page Bulletin No. 9161 covers three new 4-vane air pumps, providing a range of vacuum to 26" Hg., pressure to 13 psig and volumes from 12 to 54 c.f.m. It includes performance curves based on horsepower and c.f.m., plus dimensional data and prices.

Buffs

Williamsville Buff Co., Dept. MF, Utica, N. Y.

A four-page illustrated brochure offers a condensed description of the firm's line of buffs and polishing wheels for all buffing requirements.

Dust Collector

Pangborn Corp., Dept. MF, Hagerstown, Md.

An economical and highly efficient unit type dust collector designed to meet a wide variety of the air volume requirements throughout industry is described in Bulletin 916. This four-page folder explains the versatile cloth filter bag dust control equipment, how it is made, how it works, its range of use and application, its special features and details.

Power Rectifiers

American Rectifier Corp., Dept. MF, 95 Lafayette St., New York 12, N. Y.

A 44-page catalog covers a complete line of both standard and custom engineered power supplies, ranging in size from 50 watts to 5,000 kilowatts. Over 3,000 models are listed and described in this well illustrated 2 color catalog.

There are many special features, such as: a glossary covering terms used most frequently in power supplies; a basic power supply and control feature evaluation chart which gives an evaluation as to what type of power supply is best for what features; an electroplating guide which gives the recommended rectifier power output for common plating applications. Also, information on rectifier circuits, suggested applications for various units, diagrams, and other information designed for both the technical and non-technical man.

Plastics

Cadillac Plastic & Chem. Co., Dept. MF, 15111 Second Ave., Detroit 3, Mich.

A four-page brochure, illustrated with 12 bar graph charts, discusses and compares properties of eight new plastics, Delrin (acetal), polycarbonate, ABS, polypropylene, high density polyethylene, Penton (chlorinated polyether), Nylon 6 and FEP.

Dust Collectors

John Wood Co., Air Pollution Control Div., Dept. MF, Florham Park, N. J.

Self-contained air pollution control equipment is outlined in Bulletin #230, which illustrates and describes functions and applications of self-contained cyclone separators, fabric filters, and combination fabric/cyclone separators in low-volume systems.

Air Heater

Maxon Premix Burner Co., Dept. MF, Muncie, Ind.

Comprehensive data on direct-fired make-up air heating is given in new 8-page Bulletin AS-62, which traces the need for replacement air to compensate for that exhausted to remove dusts, fumes, vapors, and other contaminants from process equipment. It distinguishes between "make-up air heating" and "space heating", lists and illustrates the necessary components and makes suggestions on system layout, and gives detailed technical data on efficiencies, allowable concentrations of combustion products, and effect on relative humidity.

Aluminum Diffusion Coating

Alon Processing, Inc., Dept. MF, P.O. Box 11431, Pittsburgh, Pa.

A new brochure describes the Alonizing process of deeply diffusing aluminum into steel to form an iron-aluminum protective alloy with mechanical properties provided by the base steel.

Electronic pH Meter

Central Scientific Co., Dept. MF, 1700 W. Irving Park Road, Chicago 13, Ill.

A portable precision instrument for measuring the acidity or alkalinity of a solution is fully described in a new 16-page illustrated booklet.

In addition to description, specifications, and operating instructions for the electronic pH meter, the new booklet, #286, contains step by step instructions for performing several laboratory experiments.

Continuous Infrared Furnaces

Radcor, Inc., Dept. MF, P. O. Box 432, Fostoria, Ohio.

A new descriptive bulletin, BRG113, on electric infrared continuous furnaces for industrial use, contains illustrations, applications and features, highlighting the light weight and mobility of the furnaces. Also, construction, ventilation, controls and specifications are covered.

Radiant Burners

Selas Corp. of America, Dept. MF, Dresher, Penna.

Bulletin DB-2 presents a full line of "complete premix" radiant type gas units. It covers design features, construction, operating principles and advantages of Duradiant burners, and shows how and where the burners can best be used.

A complete listing of the many types available is provided, along with photos, dimension and capacity tables for each series.

Ultrasonic Cleaning

Aircraft Porous Media, Inc., Dept. MF, 30 Sea Cliff Ave., Glen Cove, N. Y.

The new ultrasonic cleaning principle incorporated in the Pall-Cavitron HIPS Ultrasonic Cleaner is discussed in an article, which describes how focused ultrasonic energy, combined with the test facilities in the unit, reliably cleans and tests fine wire mesh filter elements used in aircraft, missiles and ground support equipment as well as valves, fittings and industrial components.

Surface Roughness Tester

Micrometrical Mfg. Co., Dept. MF, 3621 S. State Road, Ann Arbor, Mich.

How to designate the characteristics of surface irregularities, how to measure the specified surface characteristics and how the Profilometer is used to measure the average roughness height are just a few of the topics covered in a new 8-page, 2 color technical bulletin.

Inspectors, quality control men and engineers will find this bulletin a helpful guide to the specifying and measuring of surface finish.

Dust
TRAP THIS DANGEROUS ENEMY with
Hammond
DUSKOLECTORS
Dust is a serious problem in most industrial plants. With Hammond DUSKOLECTORS you trap this dangerous enemy at its source before it can harm the health and efficiency of your employees and damage valuable machinery. Your cleaning and painting costs will also be reduced. Hammond DUSKOLECTORS offer you the best and most economical solution to your dust problems. Write today for catalog with helpful engineering information and interesting installation views.
"A MUST FOR DUST!"
Hammond Machinery Builders INC.
1601 DOUGLAS AVE. • KALAMAZOO, MICHIGAN

FOR THE FIRST TIME

A COMPLETELY CORROSION RESISTANT HEAT EXCHANGER

STACKED IMPERVIOUS GRAPHITE BLOCKS

•

HIGH EFFICIENCY ASSURED BY SHORT PASSAGES AND MIXING CHAMBERS

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LOW MAINTENANCE GUARANTEED

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NO FRAGILE TUBES

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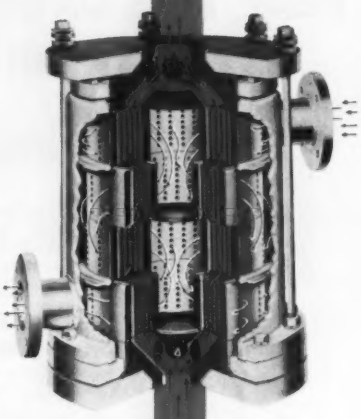
NO CEMENTED JOINTS



BEAT CORROSION—in anodizing (regular and hard coat)—nickel plating—copper plating—other plating solutions (except chrome)—pickeling solutions—acid etch—cleaning solutions—wash solutions—many other heating and cooling applications.

Package units available with piping, pump and stand.

Write for free engineering manual.

CARBONE "POLYBLOC"

THE CARBONE CORPORATION • BOONTON, N. J.

For England:
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Rotherham • Yorkshire

For rest world:
Société le Carbone-Lorraine
45 Rue des Acacias,
Paris (17e), France

BUSINESS ITEMS

M&T Appoints Four Group Vice-Presidents

Four group vice presidents have been appointed by *Metal & Thermit Corp. H. E. Hirschland* has been designated as group vice-president with the Commercial Development and Research Divisions. *B. W. Weber* is group vice-president in charge of the Manufacturing, Employee Relations and Administration Divisions. *J. L. Oberg* is group vice-president in charge of the Minerals, Ceramics and Welding Divisions; and *D. W. Oakley*, is group vice-president for the Chemicals, Coatings and Plating Divisions.

Donald W. Oakley

Mr. Hirschland started with the firm in 1941 as a process engineer in the then - newly - centralized Research Department. He has been active in research, production, sales and commercial development assignments since that time. Prior to his appointment as vice-president in 1959, Mr. Hirschland held the title of director of commercial development. A native of New York City, he graduated from Dartmouth College, class of 1939, with a Bachelor's degree in chemistry. He received the M. S. degree in Chemical Engineering in 1941 from M.I.T.

Mr. Weber joined the company in 1949 as general plant manager in the East Chicago plant. Previously he had been with American Can Co. as manager of the Seattle, Wash. plant. In 1952, Mr. Weber was appointed production manager in the New York executive offices and, in 1956, he was named manager of manufacturing. In 1959 he was appointed vice-president of manufacturing.

He received the B. S. in Mechanical Engineering in 1933 from Oregon State University.

Mr. Oberg joined the firm in 1955 as technical advisor to the president. In 1959 he was appointed general manager of the Metals & Minerals Division, and in 1960 became vice-president.

He is also a vice-president of International Titanium Corp., and supervises its operations. He received the B.S. degree in Metallurgical Engineering from Lehigh University, and completed the training course for senior executives at M.I.T.

Mr. Oakley started with the company in 1947. Previous to being appointed general manager of the Coatings Division in 1960, he was a production manager of the Manufacturing Division. He was appointed vice-president in 1960.

He received the B.S. and M.S. degrees in Chemical Engineering from Columbia University, and later attended the Columbia University School of Business.

George A. Stutz Moves to Florida and Semi-Retirement

George A. Stutz, chairman and chief executive officer of *The Stutz Co.*, Chicago, manufacturers of electrochemical and metal finishing equipment and supplies, is embarking on a new ca-

George A. Stutz

reer at the age of 72 — semi-retirement in Florida.

Though the elder Mr. Stutz is changing his status, his two sons continue in their present positions with the organization, *George L. Stutz* as president, and *Richard G. Stutz* in an executive sales capacity.

In choosing semi-retirement to total retirement, Mr. Stutz explained that it is difficult to walk completely away from the company where he spent 40 years of his life. Thus, his present status permits him to participate in management level decisions and in the over-all affairs of Stutz.

Northwest Adds New Chemicals

Northwest Chemical Co. has concluded an agreement to distribute in midwestern states the chemical specialties produced by *Conversion Chemicals Corp.* The new distribution channel enables metal finishers in the midwest, West Virginia and western Pennsylvania to obtain from a single source a complete line of quality chemicals and the combined know-how of two outstanding firms in this field.

Allied Research Appoints Guinther

Allied Research Products, Inc., Baltimore, Md. manufacturers of chemicals and equipment for the metal finishing industry, has announced the appointment of *Paul J. Guinther, Jr.* as sales engineer for the Pittsburgh area.

Mr. Guinther brings to the firm an extensive background in sales of metal products and industrial chemicals. He holds a B.S. degree from the Carnegie Institute of Technology, and is a member of the A.E.S. and the Chemical Sales Association of Pittsburgh.

His office is located at 101 Investment Bldg., 234 Fourth Ave., Pittsburgh 32, Pa.

Hooker Chemical and Parker Rust Proof Negotiating for a Merger

The officers of *Hooker Chemical Corp.* of New York and of *Parker Rust Proof Co.* of Detroit, Mich., have announced that they are negotiating for a merger of Parker into Hooker by the issuance of ¾ of a share of Hooker common stock for each of the outstanding shares of Parker, and one share of a new 5% preferred stock, $100 stated value, of Hooker for each 20 shares of outstanding stock of Parker.

Should the current negotiations result in an agreement approved by the board of directors of both companies, it is anticipated that the proposal will be submitted to the stockholders of both companies at meetings to be held early next year.

Enthone Appoints Resident Engineer for Canadian Licensee

Peter C. Noy has been appointed resident engineer at *Nicromatic, Ltd.*, of Toronto, Canada by *Enthone, Inc.*, of New Haven, Conn.

Mr. Noy, equipped with 13 years of experience in the metal finishing field,

Phillips
ALL-ELECTRIC
PERCHLORETHYLENE DEGREASERS

- REQUIRE NO WATER
- REQUIRE NO DRAINS OR CONDENSATE RETURNS
- REQUIRE NO UTILITY CONNECTIONS EXCEPT ELECTRICAL
- RECLAIM THEIR OWN SOLVENT AUTOMATICALLY

PHILLSOLV
A NONFLAMMABLE SOLVENT FOR USE IN THE PHILLIPS DEGREASER
PHILLIPS MANUFACTURING COMPANY · CHICAGO, ILLINOIS
DIAMOND ALKALI COMPANY · U.S.A.

PHILLSOLV, PHILLIPS' trade name for perchlorethylene, excels other degreasing solvents.

Here's why:

- SUPERIOR CLEANING ABILITY
- LOW TOXICITY
- HIGH BOILING POINT
- STABILITY WITH ALL METALS
- HEAVIER VAPORS
- LOWER EVAPORATION RATE
- NONFLAMMABLE — NON-EXPLOSIVE

PHILLIPS ALL-ELECTRIC vapor degreasers, designed for use with perchlorethylene, clean soiled parts faster and cost less to purchase and operate because:

HIGHER TEMPERATURE permits longer cleaning period; removes high melting point soils; permits greater solvent action.

HEAVIER VAPORS, 5.8 times heavier than air, reduces solvent loss from escaping vapor; reduces contamination of the atmosphere.

HIGH DENSITY AND HIGH GRAVITY VAPORS permit use in PHILLIPS ALL-ELECTRIC vapor degreasers without costly cooling coils and/or water jackets to control vapor levels.

Write for Bulletin 25 for all the facts on degreasing with PHILLIPS ALL-ELECTRIC degreasers and PHILLSOLV perchlorethylene.

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MANUFACTURING COMPANY
3475 Touhy Avenue
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DEGREASERS • WASHERS • DRYERS • ULTRASONICS • DEGREASING SOLVENTS

Peter C. Noy

will work closely with Nicromatic in solving the finishing problems of its customers. He attended Queens University in Kingston, Ontario, Canada prior to obtaining experience as a plant manager, planning engineer, and chief chemist. He spent the past two years as chief chemist for Nicromatic, Ltd.

Pittsburgh Plate Glass Constructing New Plant

The Chemical Division of *Pittsburgh Plate Glass Co.* has started construction of a methyl chloroform plant at Lake Charles, La. The new unit is scheduled for production by the Fall of 1962.

A new process for methyl chloroform production was developed by the division's research & development personnel, and extensive pilot plant operations have been under way in the company since 1960. An industrial solvent, the product is being marketed under the trade name "Tri-ethane."

Field Joins Mitchell-Bate

Joel R. Field, Jr., formerly of Enthone, Inc. and more recently with Chas. Dickgiesser Co., Derby, Conn., is now associated with *Mitchell-Bate Co.*, rack manufacturers, Waterbury, Conn.

Mr. Field brings many years of broad experience in plating rack design to his new post. He will concentrate on the development of new rack designs.

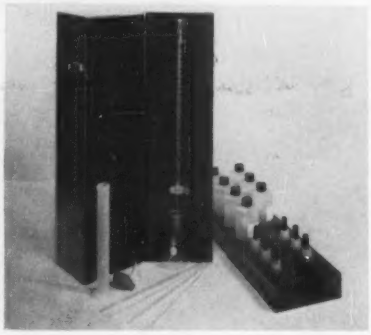
Stokes Expands Representation in Rochester

F. J. Stokes Corp., Philadelphia, has added *J. Hervey Sternbergh* to the field sales staff of its Rochester, N. Y., district office.

Mr. Sternbergh, who will concentrate on the products of the Vacuum Division, is a native of Reading, Penna., and has been traveling Upper New York State for the past ten years as a representative for hydraulic equipment, mechanical products, and other items. He was graduated from Cornell University in 1939, with an A.E. in M.E. degree. During World War II, he served as a B-25 pilot in the Air Corps.

"Trouble-Shooting Kit" Speeds Solution Analysis for MacDermid Customers

Customers of *MacDermid Inc.* who lack the facilities for a fast, trouble-shooting check of their metal finishing solutions can now take advantage of the firm's newest service, a compact but complete trouble-shooting kit. By using his new "Trouble-Shooting Kit" right in the customer's plant, the firm's representative can not only pin-point the source of trouble immediately, but also make the necessary recommendations to solve the problem.



Since samples of the solution in question no longer have to be sent or taken to the supplier's laboratory for analysis, platers can now restore their bath to trouble-free operation with a minimum of down-time.

Union Carbide Plastics Assigns Technical Rep.

Allan J. Costantin has been assigned as a technical representative in the mid-western sales region of *Union Carbide Plastics Co.* He will be located in the district sales office at 6300 N. Central Expressway, Dallas 6, Texas (Emerson 3-1691).

Mr. Costantin joined the company in 1954 after receiving a Bachelor of Science degree in Chemistry from Worcester Polytechnic Institute. Following completion of the company's extensive sales training program, he was assigned as a technical representative in the New York area and was later transferred to the San Francisco office where he had served until his recent assignment.

Bradley & Vrooman Adds New Representative

Walter L. Churchill has joined the *Bradley & Vrooman Co.*, Chicago, as technical service and sales representative. His territory will encompass Wisconsin, Minnesota and Iowa.

Mr. Churchill brings with him a wide background in chemical coatings and appliance finishing, having been a technical service and applications engineer in these fields for many years.

He will headquarter at 205 Rivoli Building, LaCrosse, Wis.

Baker Distributing Relocates

Baker Distributing Co. has moved to 32750 Solon Rd., Solon 39, Ohio, telephone 248-6299. They have moved to more modern quarters in a less congested area of greater Cleveland in order to better service their metal finishing customers. The firm is also increasing its activity in the sales and service of ultrasonic equipment and now have provision for ultrasonic cleaning of parts on a jobbing basis, as well as a large stock of equipment available for sale and rental.

Stevens Joins Hubbard-Hall

Hubbard-Hall Chemical Co., Waterbury, Conn. has announced the appointment of *Roger G. Stevens*, 1412 Whilden Place, Greensboro, N. C. as metal finishing technical representative. He will service accounts throughout the Carolinas, Virginia and West Virginia.

Prior to joining the firm, Mr.

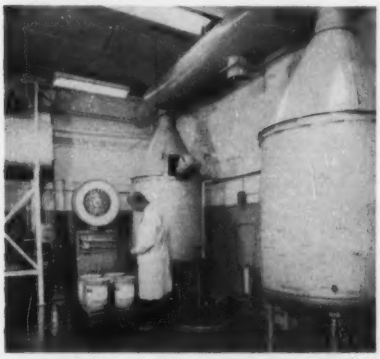
Roger G. Stevens

Stevens worked in the metal finishing field for six years as representative for the Southeastern Equipment Co., Vero Beach, Fla. Before that, he was associated with a chemical company in Greensboro.

Mr. Stevens is a member of several professional societies including the Blue Ridge Chapter, A.E.S.

Enthone Installs Production Facility

A new production facility for the large scale production of its recently released 'Enplate' chemical plating process has been installed by *Enthone, Inc.*, of New Haven, Conn. This installation facilitates the production of high-purity chemical plating solution concentrates, in addition to greatly increasing the output capabilities of the firm in this field.



The highly purified chemical plating products are produced with deionized water. The equipment is all constructed of stainless steel and plastic in order to avoid contamination of the solutions.

Kenfucius say: *Man who cadmium plates may have strange problems*

TEST THIS WEEK PROBLEMS

Stains before dipping
Poor Solderability
Spotting out (after 3 months)
Brittle cadmium
Blisters
Pits
Streaks
Rough plate
Burning
Fog or cloud on chromating

NEW PRODUCT

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ANSWERS

Convert to KENVERT

A complete line of compatible brighteners and post treatments, matched and balanced to guarantee uniform acceptable results

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Meets Government Specifications

Send prepaid a sample of your plating solution and parts for free diagnosis and recommendation.

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LICENSEES:
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Distributors throughout the U.S.

Cahnman Now Manager of Ramco Oven Division

Hugo N. Cahnman, electrical engineer, has been made manager of the Electric Oven Division of *Ramco Equipment Corp.*

Mr. Cahnman received his extensive training in Europe, where he graduated from the University of Delft, Holland. In Europe, he worked as a sales and field engineer, was head of a sales and service organization of a large European telephone and signal company and became a member of the board of directors of that concern. After about 12 years, he established his own factory in Amsterdam, Holland, shortly before W.W.II, manufacturing mechanical-electrical parts, and commercial lighting and heating fixtures. His company flourished until, in 1942, the German occupation put an end to his commercial and professional activities.

Hugo N. Cahnman

Mr. Cahnman came to this country in 1946. He specialized in industrial heating and heat control and was associated with a manufacturer of electric heating units and elements for 11 years. After this period he established himself as a consulting engineer in the field of applied electrical heat for the industry.

Gurnham Resigns from Michigan State

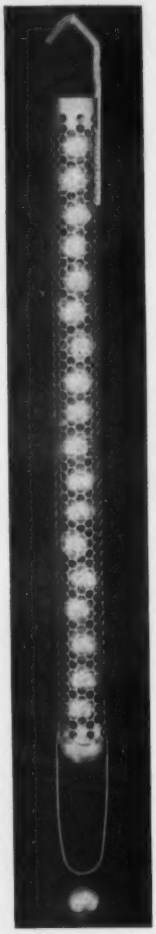
C. Fred Gurnham, professor, and head of the Department of Chemical Engineering, Michigan State University, has resigned from the University

NEST OF NICKEL BALLS GIVES NEW METHOD IN NICKEL PLATING BY UNIVERTICAL

BALL NICKEL ANODES IN TITANIUM BALL ANODE CONTAINERS . . .

provide positive improved control of uniform plate thickness through controlled constant anode area . . . With these additional benefits:

- Thirty per cent more anode area exposed with one-half the weight of nickel required.
- Eliminates scrap generation and costly scrap remelt charges and shrinkages.
- Eliminates floating bags, especially in air agitated baths — and cutting of bags caused by anode spears.
- Carbon sludge drops in a special pouch provided at the bottom of the container through bail device, allowing longer plating production time between shutdowns.
- Eliminates the need of blind checking nickel bar anodes for required anode area.
- Eliminates polarization.
- Eliminates nickel salt additions through constant anode area.



UNIVERTICAL CORPORATION

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Producers of Rolled, Cast and Forged Anodes, since 1939

as of October 31st. He will establish his own practice as a consulting chemical and sanitary engineer, specializing in the field of industrial waste and disposal.

Dr. Gurnham came to the university in 1952 from a similar position at Tufts University, in Massachusetts. During his administrations, the Departments of Chemical Engineering at both universities were accorded official recognition by the American Institute of Chemical Engineers and the Engineers' Council for Professional Development.

Dr. Gurnham received his engineering training at Yale University and New York University. He was cited in 1955 as a Distinguished Alumnus of New York University. He is licensed as a Professional Engineer in several states, including Michigan, and is a Diplomat of the American Academy of Sanitary Engineers. In addition to his teaching experience, he held responsible positions in industry for several years.

Professor Gurnham has been active in many professional engineering and scientific societies. He is currently Chairman of the American Institute of Chemical Engineers' Pollution Control Engineering Committee, member of the Professional Development Committee and the Committee on Background of Professional Ethics, and AIChE delegate to the American Standards Association Committee on Toxic Dusts and Gases. In addition to the AIChE, he is a member of the American Society of Civil Engineers, the American Institute of Mining, Metallurgical and Petroleum Engineers, the Society of Mining Engineers, the American Chemical Society, the Water Pollution Control Federation, and other similar associations. He was recently appointed to the Ethics Committee of the Engineers' Council for Professional Development.

Pettit Joins Circo Corp.

Jack L. Pettit, for the past four years with the Carr Fastener Corp., Cambridge, Mass., where he was chief manufacturing engineer, has joined the *Circo Corp.*, Clark, N. J., as director of manufacturing.

Jack L. Pettit

Mr. Pettit, a graduate of Stevens Institute of Technology, has eighteen years previous experience in the industrial cleaning industry, in design, sales, engineering and management capacities including vice-president and general manager.

Free Course in Electroplating

The course of study in electroplating given at the Fort Greene Evening High School, 29 Fort Greene Pl., Brooklyn 17, N. Y., will begin its Spring Term on February 1, 1962.

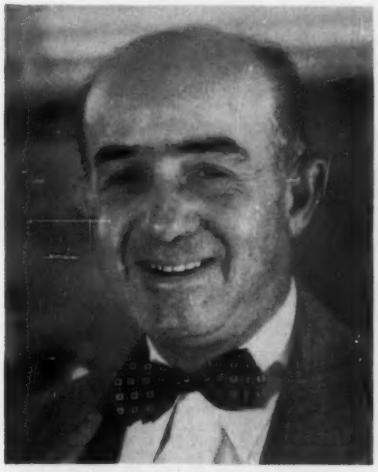
The session is divided into classroom discussion and laboratory experiments. The classroom topics will include simple calculation, reading graphs, chemistry of the plating tank, pH, wetting agents, pitting, deionizing. The laboratory experiments will include solution analysis, Hull cell studies, anodizing.

Registration will be held January 29,

30, 31, 1962. Class sessions will commence Thursday, February 1, 6:45 P.M. Classes will meet on Tuesdays and Thursdays from 6:45 to 8:15 P.M., including about 6 Fridays. The term begins February 1, 1962 and ends June 26, 1962. Register with *L. Serota* in Rooms BW17 or 3E12.

Walter Pinner Enters Consulting Field

Walter L. Pinner, a Past National President and Honorary Member of A.E.S. and of the Institute of Metal Finishing of England, announces that he is no longer associated with *McGean Chemical Co.* After a vacation trip, Mr. Pinner plans to establish residence in



Walter L. Pinner

the South West where he will be available for consulting work. Prior to his three years employment by McGean, Mr. Pinner had served Houdaille Industries and its predecessor companies for thirty-five years. In that connection, he was responsible for the technical direction of research and manufacturing procedures in one of the largest nickel and chromium plating operations in the country.

During November of this year, Mr. Pinner visited England on behalf of the Pyrene Co. of London for whom he has acted as a consultant for fifteen years.

During his long and successful business career, Pinner has interested himself to a considerable degree in basis metal preparation, copper, nickel and chromium plating and corrosion. Many of his publications on these subjects have resulted in numerous awards and honors to him.

Mr. Pinner was instrumental in setting up A.E.S. Project 15 and has served as chairman of the Project Committee since its inception. The work of that group has produced the CASS and Corrodkote tests which are in widespread use in the plating industry.

For Advanced Ideas In Immersion Heating . . . N. J. THERMEX

An exciting new concept in industrial immersion heating is now a reality. Write immediately for specific details explaining the modern principles and advantages of THERM-X-RED® Immersion Heaters.

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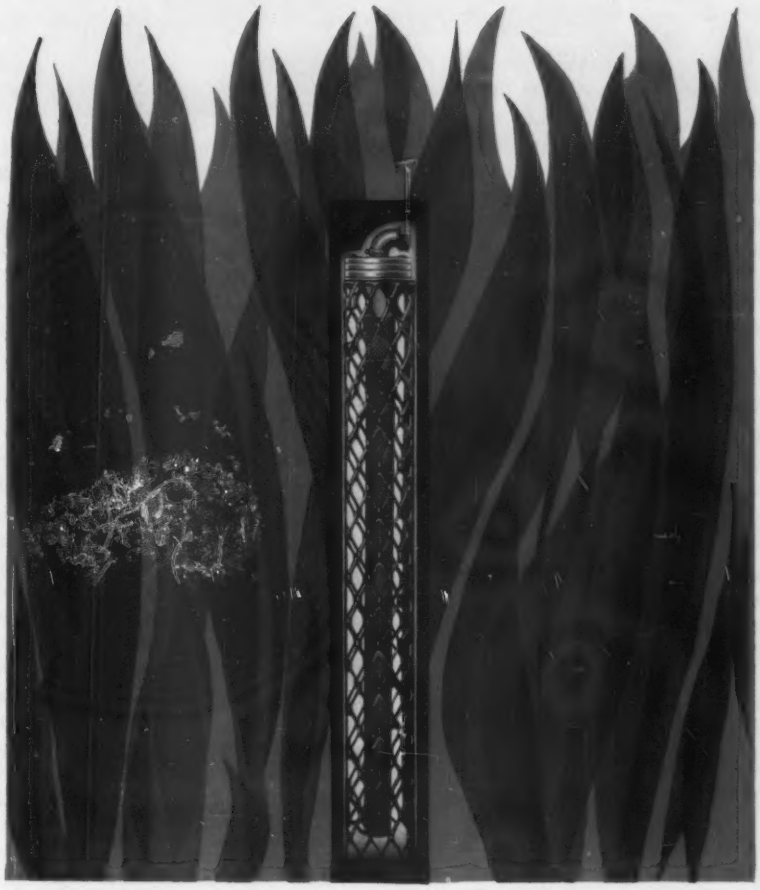


Infilco Consolidates Important Operations

Consolidation of all *Infilco, Inc.* municipal water and sewage treatment operations in the United States and Canada into a newly formed Public Works Department was announced recently. *G. E. Hauer*, who has been in charge of the municipal sewage and biological waste treatment activities, will manage the new department.

Also announced at the same time was consolidation of the company's industrial operations into one department under the management of *H. W. Frazer*. Previously in charge of activities in ion exchange and demineralization fields, Mr. Frazer will now be in supervision of all work in water and waste treatment for all industries.

Alvey-Ferguson Appoints Illinois Representative

J. W. Harvey Co., 8000 W. 47th St., Lyons, Ill., has been appointed Illinois State representative for *Alvey-Ferguson Co.* Established in 1955, the Harvey company was organized to serve the metal processing industry. Mr. Harvey, with a background of more than 15 years in metal processing, is assisted by *Hal Truman*, who has also

had a long and varied experience in the metal processing field.

Shipley Names Perham Technical Representative

J. Newton Perham has been appointed technical representative for the *Shipley Co.*, according to an announcement. He will concentrate on special plating problems in the Eastern United States.

Before joining the firm, Mr. Perham had been with Texas Instruments, Metals & Controls Div., as a sales and service engineer in connection with precious metal plating. He is also the author of several technical articles on metal plating solutions, an inventor and patent-holder, and an instructor who has conducted seminars throughout the United States on proper plating techniques.

A native of Islington, Massachusetts, Mr. Perham holds a B.S. degree from Northeastern University, class of 1938.

Allied Research Opens New Warehouse

Allied Research Products, Inc., Baltimore, Md. manufacturers of chemicals, equipment and supplies for the metal finishing industry, has announced the opening of a new warehouse and service laboratory at 35 Holland Avenue, Bridgeport, Conn.

Warehouse operations will be under the direction of *L. Frank Richard*, district sales manager.

Central Industrial Contracting Relocates

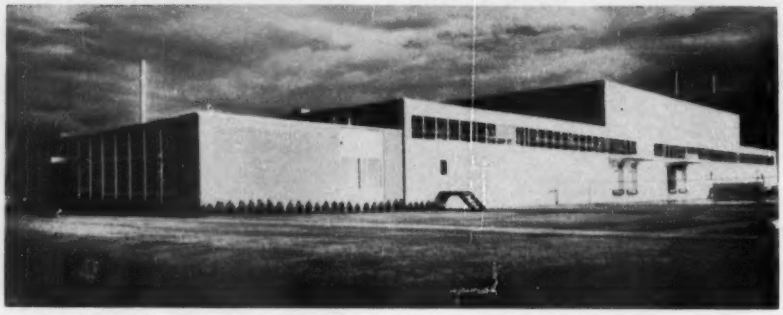
Fred Weiss, president of *Central Industrial Contracting Co., Inc.*, announces that the firm has moved to new and larger quarters at 70 Richardson St., Brooklyn 11, N. Y. The telephone number remains STaff 2-4880.

Canada's First Detinning Plant Goes on Stream

Canada's first detinning plant went on stream in Hamilton, Ont. on Nov. 2. Opening ceremonies for the new $1.25-million facility of *M&T Products of Canada Ltd.* were attended by several hundred Canadian business executives, educators and members of government.

The alkaline detinning process is used to remove tin from high quality tinplate scrap produced in can-making operations. Tin chemical by-products now provide Canada with her first domestic source of sodium and potassium stannate.

Wyandotte Opens New Canadian Plant



Opening its new plant recently in Scarborough, Ontario, *Wyandotte Chemicals Ltd.*, J. B. Ford Division began production of a complete line of cleaning products for business and industry. It has immediate access to route 401 and is served with a rail siding and ample truck docking.

Terence Neill, a native of British Columbia, who has for 9 years been the firm's Canadian sales manager, has been elected a director of the new company and named director of sales.

P. H. H. Ridout of Manning, Bruce, Peterson & Ridout, Barristers and Solicitors, Toronto, becomes secretary.

New Emphasis on Paint Chemicals at Dow

Expanded and more efficient company activity in the paint chemicals area is expected through formation of a new paint section in its Technical Service and Development laboratory, *The Dow Chemical Co.* has announced.

Initial responsibilities of the paint section include technical service for thickener and mildewcide products. In time, surfactant, emulsifier, preservative, flow control agents, paint remover, solvent, wetting agent, and other chemical products for paint will also be handled by the section, according to the company.

Head of the paint section is *Robert H. Lalk*, who has 16 years experience as a coatings chemist, seven years as head of the paint testing section in the firm's coatings technical service.

New Equipment and Supply Company Formed

Plating & Polishing Equipment & Supply Corp., 286 Kinderkamack Rd., River Edge, N. J., announces that the firm, which has served as a 40,000 sq. ft. warehouse facility for the trade, is now operating as a full equipment and supply house, with *Harvey S. Levine* in full charge.

The equipment in transit operation is now located at 624 Paterson Plank Rd., E. Rutherford, N. J., where space has been leased for the parking of 20 trailers. This location is 15 minutes from midtown New York and provides for convenient inspection of the larger

Harvey S. Levine

and automatic equipment handled by the firm, which will act as sales representative, distributor, equipment rebuilder and, in the near future, will market packaged finishing plants.

Mr. Levine, a licensed New York auctioneer and New Jersey constable, will continue this liquidation work, in addition to serving a small group of firms as a management and technical consultant. He has been associated with the metal finishing field as a plater, equipment and supply dealer, and consultant for almost 25 years.

M&T Appoints International Representative

Nathan H. Dewing, Jr., has been appointed a representative for *Metal & Thermit Corp.'s* International Division. He will be primarily concerned

with expansion of overseas business sales and subsidiary operations. His offices are in the firm's New York headquarters.

Mr. Dewing previously worked for the international division of Merck & Co., Inc. Graduating cum laude with a B.S. degree from Boston University, class of 1952, Mr. Dewing completed a year's study at the Graduate Institute of International Relations, Geneva, Switzerland. He also holds an M.A. degree from the Woodrow Wilson School of Foreign Affairs, University of Virginia.

Malone Heads Up New Circo Chemical Division

Edmond Malone has joined *Circo Corporation*, subsidiary of Branson Instruments, as manager of the new chemical products division, which will supply a complete line of cleaning, metal finishing, and rust preventive compounds marketed under the name of Circo-Branson with the brand name of "Cobra." Complete facilities are available for custom processing of cleaning problems.

Edmond Malone

Mr. Malone comes to the company with a wealth of experience, having spent 8 years with another leading manufacturer of cleaning chemicals.

Binks Appoints Distributor

O'Donohue Industries, 3818 N. Hubbard St., Milwaukee, Wis., distributors of industrial chemicals and equipment for metal cleaning and finishing, have been appointed exclusive distributors for the Pred Division of *Binks Mfg. Co.*, Chicago, Ill., in Wisconsin and the Upper Peninsula of Michigan. A complete test installation has been installed for customer product application testing.

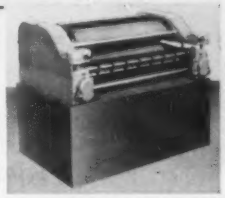
MURRAY-WAY SPECIALIZED FINISHING EQUIPMENT

JUNIOR FLAT POLISHER— versatile production unit for economically grinding, polishing, or deburring flat surfaces.

HORIZONTAL-PLATEN CONVEYOR built to fit your exact requirements.

POLISHING AND BUFFING TABLE— small dial table has abrasive belt head and buffing head for spiral aluminum shapes

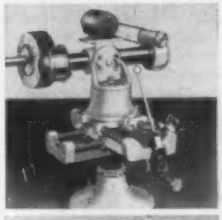
ECONOMICAL LATHE— stripped of many unnecessary "frills" to keep costs to a minimum.



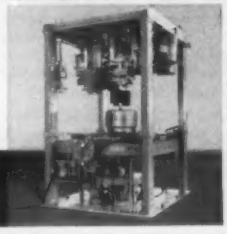
ROLLER COATER— a trouble-free, precision unit that coats one or both sides of a sheet.

...IMPROVES QUALITY, REDUCES COSTS FOR METAL PRODUCTS MANUFACTURERS

Polishing, buffing, grinding, filtering, deburring, materials handling . . . whatever your problem, Murray-Way equipment will do the job better and more economically. Fresh ideas based on a solid background of experience, enable Murray-Way's fine engineering and production departments to handle any and all of your production problems— large or small. The BETTER WAY is the MURRAY-WAY.



HAN-D-MATIC— low cost machine with interchangeable components for buffing, grinding, and deburring.



WIRE BRUSH MACHINE— deburrs automatic washer and dryer basket holes prior to painting.

MURRAY WAY

MURRAY-WAY CORPORATION
P.O. BOX 180 • MAPLE RD. EAST
BIRMINGHAM, MICH.

New Plant for Handy & Harman

Handy & Harman, fabricators and refiners of precious metals, announces the relocation of its New York plant from 82 Fulton St., N. Y., to 525 Nuber Ave., Mount Vernon, N. Y.

Modern and improved machinery has been installed in the new plant to facilitate production of a wide variety

WHY GUESS ?

MEASURE PLATING THICKNESS

to a millionth of an inch

Your profits depend on meeting tight specifications, maintaining quality control and reducing rejects. Can you afford to guess at plating thickness when it is so easy to *measure and be sure*?

UNITRON'S PL-MEC PLATER'S MICROSCOPE substitutes facts for uncertainty. The plated deposit is observed through a Filar Micrometer Eyepiece and measurements are read directly from a micrometer drum. This compact microscope is easy to use, portable around the shop and has a built-in light source. It also doubles as a metallurgical microscope for examining grain structure etc. at magnifications of 25X-1500X. Permanent photographic records may be made using an accessory 35mm. camera attachment and provide valuable legal protection for subcontractors.

UNITRON'S PLATER'S MICROSCOPE will save its initial cost many times over. Prove this for yourself — as so many firms in the plating industry have done—by requesting a **FREE 10 DAY TRIAL** in your own plant. There is no cost and no obligation.

Above: Accessory camera attachment.
Left: Observing the plated deposit.

$468 Model PL-MEC complete with all optics and standard accessories	As above with built-in camera attachment, but without 35mm. camera back: **$540**

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of karat gold alloys for manufacturing jewelers and industrial users.

M&W Names Midwestern Div. Mgr.

Robert B. Stevens

Robert B. Stevens has been named manager of the Midwestern Division of *Maas & Waldstein Co.*, Newark, N. J., manufacturers of industrial finishes and chemical coatings. He will headquarter at the Chicago plant and will be responsible for sales and service in the nineteen state area which comprises the division.

Abbey Automation Systems Now in New Location

Abbey Automation Systems, Inc., has announced that manufacturing and engineering facilities have been moved to their new site at 232 Varet St., Brooklyn, N. Y.

With the acquisition of a building large enough to house engineering, design, manufacture and sales, customer requirements can be more expeditiously and economically processed. The new site, complete with demonstrating equipment and conference rooms, is available for visitation. A full and competent technical staff to discuss processing and design may be consulted. Supplies and equipment for processing will be stored at present site.

Samuel Moore & Co. Expands

Samuel Moore & Co., manufacturer of extruded plastic products in Mantua, Ohio, which only a year ago completed a 70 per cent plant increase, is now expanding again. The current expansion, which is the seventh since 1947, will bring plant floor space to 80,000 square feet from the present 50,000 square feet, it is reported.

This latest addition is well under way and is slated for completion early in January. The current project, including new equipment to be installed, will represent an investment of about $250,000.

Pangborn Corp. Assigns Szabo to Cleveland District

Alex J. Szabo has been assigned to a new position by *Pangborn Corp.*, as sales engineer, Cleveland district. Born in Roumania, educated in Canada (graduate of McGill University) Mr. Szabo worked as a methods engineer at Ford Motor Co., then joined Pangborn in 1956 as sales engineer, Detroit. For the past year he has been supervisor, Vibratory Finishing Division in the Hagerstown, Md. plant.

Lonyai Named General Sales Manager at Fidelity

Seymour B. Lonyai has been named general sales manager of *Fidelity Chem. Prods. Corp.*, according to an announcement. He will direct all sales activities, including those of the newly established Electronic Chemicals Division.

Mr. Lonyai began his career with the company 16 years ago as a technical sales representative. He was a supervisor in the metal finishing department of Bendix Aviation Corp. before that.

Mr. Lonyai is a graduate of the National Agricultural College in Doylestown, Pa. He has done graduate work in metallurgy and chemistry at New York University and Newark Col-

Seymour B. Lonyai

lege of Engineering. He is a member of the A.E.S., the American Society for Metals and the Industrial Management Club.

O'Brien Names Hathaway

Robert J. Hathaway has joined *The O'Brien Corp.* as technical salesman in the Chicago area.

Robert J. Hathaway

From 1958 to June 1961, Hathaway worked for Spaulding Fibre Co., Inc., Chicago. From 1955 to 1957 he was associated with both Bradley & Vrooman Co., and the Paint and Varnish Division of E. I. du Pont de Nemours & Co., in Chicago.

A native of Chicago where he graduated from Lane Technical H. S., Hathaway received his B.S. degree in Chemical Engineering at Northwestern University in 1958. He is a member of the American Institute of Chemical Engineers, Chicago Duplicate Contract Bridge Assn. and the Evans Scholar Alumni Assn.

Hercules Announces Appointments

Two new managerial appointments in the Coatings Division of Hercules Powder Company's Polymers Department were announced recently. The new appointments are: *James R. Yeager,* assistant to the director of coatings materials sales, and *Gregory N. Bruxelles,* manager nitrocellulose sales.

Mr. Yeager, who has been manager of nitrocellulose sales since 1956, brings to his new post a broad background of experience in both sales and production.

Starting as a chemist in 1923 at the Experiment Station, at that time located in Kenvil, N. J., he was transferred to the Parlin, N. J., plant in 1924, where he subsequently became nitrocellulose superintendent. He was transferred to the home office in 1943 as supervisor of lacquer marketing. Since that time, he has been closely connected with nitrocellulose sales and market development of nitrocellulose lacquers in new and established fields. From 1949 to 1952, he was manager of the department's New York district sales office, and from 1952 to 1956, he was manager of lacquer promotion in the home office in Wilmington.

Mr. Bruxelles, who joined the firm in 1947 as a chemist upon graduation from Harvard, has extensive experience in coatings research as well as sales. From 1947 to 1956, he was at the company's research center, where his assignments included work leading to the more extensive use of lacquer by industry. During the latter two years, he was supervisor of the coatings laboratory at the research center. In December, 1956, he was transferred to the Polymers Department in the home office and, in 1957, was named manager of the department's Cincinnati district office, the position he held until this new appointment.

Landau Appoints Sanches

Joseph A. Sanches has been appointed sales manager for the *J. Landau & Co., Inc.* of Carlstadt, N. J.

Mr. Sanches joined the firm after serving as sales manager for Nordsen Eastern, Inc. A native of New York, he comes to the firm with twenty years of experience in the finishing field, and is well known throughout North-Eastern U. S. His extensive knowledge of

Joseph A. Sanches

finishes, combined with his experience in airless and hot-spray, encompasses a unique specialized service for the company.

Luster-on®

THE FIRST AND FINEST IN CONVERSION COATINGS FOR BRASS, ZINC, CADMIUM, COPPER, ALUMINUM

The Chemical Corporation offers a complete line of uniform-controlled chromate conversion coatings that provide maximum protection in one, low-cost, simple operation. Available for immediate delivery as liquids or powders.

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FOR BRILLIANT CORROSION-RESISTANT FINISHES . . . rivaling chrome for many applications where cost is a factor. Long-lasting, easily controlled application.

FOR CLEAR, BRIGHT and IRIDESCENT COATINGS . . . gives striking, attractive appearance with complete corrosion-protection . . . even when humidity and handling are involved during processing. Also yellow iridescent and olive drab for concealed parts or as a paint bond.

FOR DECORATIVE COLOR . . . on low-cost zinc. Brilliant golds, yellows, blues, greens, violets, reds, brass and copper hues.

FOR ALUMINUM . . . replacing costly anodizing where surface hardness is not of prime importance. Excellent finish for paint bonding. Save 25% or more with Luster-on complete package treatment: cleaners, de-oxidizer, sealer.

FOR LASTING BRIGHTNESS . . . on both copper and brass without noxious fuming.

FOR DIE-CASTINGS . . . one quick dip provides uniform finish, ideal as a base for painting.

We'd like to show you what Luster-on can offer you! Send in sample part today for free processing. Data sheets on request.

BLAKODIZE* . . . chemical black treatment for steel, provides lustrous, rich, black finish with good degree of penetration and rust resistance.

*T.M. Reg.

The Chemical Corporation

58 Waltham Avenue • Springfield, Mass.

Handy & Harman Providence Plant Relocates

The Providence plant of *Handy & Harman*, fabricators and refiners of precious metals, has moved to a new location at 845 Waterman Ave., East Providence, R. I. It was formerly at 425 Richmond St., Providence.

A complete stock of gold and silver products, brazing alloys and fluxes will be carried in the plant, which is also the New England collection station for precious metal refinings.

D. R. Savage Named Service Manager of Sames

Daniel R. Savage has been named service manager for the American operations of *Sames* (Societe Anonyme de Machines Electrostatiques), major French electronics firm and recognized pioneer in the field of electrostatics. He will be responsible for management of all service operations on installations and equipment throughout the U. S. This includes the company's high voltage power supplies, particle accelerators and electrostatic spray equipment. He will make his headquarters at 30 Broad St., New York City.

Prior to joining the firm, Mr. Savage was associated with the Texas Nuclear Corp. as service and installation manager. Earlier, he was with Sorenson and Co. for ten years in a variety of engineering and service positions.

Mr. Savage is a graduate of Eastern Military Academy, University of Connecticut, and the Bridgeport Engineering Institute where he studied electrical engineering.

Detrex Appoints Schlossberg

Detrex Chemical Industries, Inc., has announced the appointment of *Louis Schlossberg* as research manager, Chemical Processing Division.

Mr. Schlossberg received his Master's Degree in Chemistry in 1947 and has been active since that time in metal research and product development. His most recent assignment was manager for a steel mill division, where he developed chemical specialties for steel strip mills.

Louis Schlossberg

Burden Appointed Manager Product Development for L. H. Butcher Co.

L. H. Butcher Co. has announced the appointment of *John W. Burden* as manager of the product development department.

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Better Buffing and Polishing
Your best bet's
FORMAX
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Formax manufactures a complete line of Buffing and Polishing Compounds in bar, tube and liquid form suitable for all classes of metal, plastic and lacquer finishes. Formax compounds used together with the famous Formax long wearing buffing wheels make a combination that's hard to beat. Our extensive manufacturing, laboratory and testing facilities are always at your disposal.

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Synthetic
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BAKE OR AIR DRY
For Your Product Made of Metal, Plastic, Wood or Glass.
Write for sample. Specify application and choice of vehicle.

New . . . 12 PAGE TECHNICAL BROCHURE AND CONVENIENT WALL CHART AVAILABLE ON REQUEST
. . . See at a glance the properties of many natural and synthetic pearl pigments, their chemical and physical characteristics, and recommended uses.

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A division of Rona Laboratories, Inc.
EAST 21 & 22 ST., BAYONNE 3, NEW JERSEY
Largest Exclusive Manufacturers of Pearl Essence
Plants: Maine • New Jersey • Canada

John W. Burden

Mr. Burden graduated from the University of Southern California in 1943 with a B. E. in Chemical Engineering. He served in the Army Air Corps from 1943 through February, 1946. In 1947 he obtained his Master's Degree in Chemical Engineering from U. S. C. and graduated Magna Cum Laude. After receiving his Master's Degree, Burden entered the employment of Standard Oil Co. of California at the El Segundo refinery and remained with that company until October of 1961.

Usera Joins Hooker's International Division

Julio J. Usera has joined the recently formed International Division of *Hooker Chemical Corp.*, located at corporate headquarters, 666 Fifth Ave., New York. His title, director of sales, designates responsibility for managing sales of the division.

Mr. Usera has been in a similar field with Monsanto Chemical Co. for the past 15 years. Since 1959 he had been director of sales of their Overseas Division. Previously at Monsanto, he was successively a sales representative in the foreign department, then district manager of the Overseas Division, in New York City. From 1955 to 1959 he was European resident supervisor, located in Paris, France.

He has also been a special representative in South America for Shick, Inc.; Argentine representative for Borg-Warner International Corporation; and a member of the auxiliary staff of the U. S. Embassy in Buenos Aires.

Mr. Usera attended the U. S. Naval Academy, and is a member of the Naval Academy Association, Annapolis, Md.

NEWS FROM CALIFORNIA

Alert Supply Co., which has operated from headquarters in Los Angeles for the past nine years, on October 1 moved into its new manufacturing, warehouse, laboratory and office facilities at 7343 Paramount Blvd., Pico-Rivera, Calif.

The location is in the eastern area of Los Angeles County, approximately 15 miles from downtown Los Angeles. The 60,000 sq. ft. plant has been divided into areas of 25,000 sq. ft. for manufacturing buffing compounds, pla-

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USE TRUE BRITE BRASS SOLUTIONS

Trouble Free — Low Cost
Little Supervision Needed
Ready To Use — Just Add Water
Uniform Color — Can Match Colors

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Our Compliments of The Season

AGATE LACQUER MFG. CO., INC.
SERVING INDUSTRY SINCE 1927
11-13 43rd Road
Long Island City, N. Y.
Stillwell 4-0660-1

AGATEEN!
THE LAST WORD IN QUALITY

ting chemicals, cutting anodes, etc.; 30,000 sq. ft. for warehousing proprietary materials, equipment, and supplies; and 5,000 sq. ft. for laboratories and office facilities.

Two laboratories have been installed, each about 15 by 30 feet in size. One is equipped for analysis and control of solutions, the other for customer processing.

Pacific Extrusions, Inc., Watsonville, Calif., has completed installation on a new aluminum anodizing facility. Housed in a new 15,000 square foot addition to the main plant, the new equipment includes a series of 27-foot-long processing tanks, a 12,000 ampere rectifier and modern refrigeration facilities. The set-up is designed to do custom anodizing of aluminum sheet and extrusions.

William Thomas, formerly with Crown Chemical & Engineering Co. of Los Angeles, recently joined the organization of the H. C. Wells Co., manufacturers of plating shop equipment and supplies.

The firm, founded by *Harold C. Wells* (also a Crown alumnus) earlier this year, has headquarters at 5300 East Beverly Blvd., Los Angeles. Another addition to the staff is *Mrs. Lee Granger*, who serves as secretary.

Wells reported that papers of incorporation have been filed and, when this procedure has been completed (possibly by January), the corporate officers will be: president, Wells; vice-president, Thomas; and secretary, Mrs. Granger.

When *Paul Franke*, formerly plating foreman for the Price-Pfister Co. of Los Angeles, retired in 1960 after nearly four decades as a metal finisher, he vowed vigorously that he would — "never look at the inside of a plating shop for the rest of my life."

But nearly a year and a half of such activity as gardening and TV watching changed Paul's mind. He responded like the storied old fire horse when an emergency developed. When circumstances took day plating foreman *Roy Churchtown* out of action for a short period in October, a phone call went out to the home of Paul Franke:

"Would he be interested in acting as day plating foreman for a couple of weeks until Churchtown returned?" was the question.

Would he? . . . . Paul got to the Price-Pfister plant so fast, his fellow workmen are sure he must have taken a jet plane. And, according to *Nate Robinson*, night plating superintendent, for three weeks Paul had himself a great time doing exactly what he had vowed he would never put a hand to again.

The Henry Soss Co. of Los Angeles recently expanded its production facilities by installing a complete package process system for plating builders' hardware. The set-up includes approximately 35 tanks of varying size, from 50 to 300 gallons each, for plating with cadmium, nickel, dull nickel, brass and bronze. The installation is powered by four new rectifiers.

San Diego Branch of the A.E.S. has assured itself of good attendance at its monthly meetings by requiring every member who attends to bring along at least one non-member guest. The effectiveness of the procedure was dem-

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EXCLUSIVE LICENSED FRANCHISES FOR

CHROM-LUME

DIRECT CHROME COATING...TO ALUMINUM!

Diversify for bigger profits! Unique CHROM-LUME process bonds sturdy chromium to lightweight aluminum. It's "3-D" – Direct! Dense! Ductile! Ready-made markets in electronics, aviation, astronautics, missiles, etc.

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CLEAR LACQUERS for BRASS

- High Gloss — Spray or Dip.
- Air Dries to Bake Hardness.
- Amazing Adhesion on Polished and Non-Polished Brass.
- Will not Blush-Tarnish nor Discolor.
- Hardens with Age.
- Remains Flexible.
- Withstands All Kinds of Weather Conditions.

HARDEX Lacquers are made for all Metal Surfaces.

Convince yourself — order Trial gallon at Drum price!

NEW ENGLAND COATING WORKS, Inc.
Manufacturers of Quality Coatings
349 Bryant Ave., New York 59, N. Y.
Tel.: DAyton 9-7800

onstrated on October 10 when some 60% of the members present introduced a guest.

Frederick Stevens, manager, Los Angeles Industrial Division, Behr Manning Co., addressed the branch on "New Ideas and Concepts in the Use of Coated Abrasive Products." He addressed Los Angeles Branch on the same subject the following night.

Milton Weiner, director of the Weiner Laboratories, Santa Fe Springs, Calif., has announced that Training Program B of a three-section course in electroplating he is offering, will be presented every Monday night for 12 weeks, beginning January 8. Chemistry and electrochemistry, and their applications in plating, will be the subject.

California Metal Enameling Co. of Los Angeles now has in operation a new pickling system in its metal finishing department which includes seven tanks of 3,200 gallon capacity each. The individual tanks measure 26 x 3 x 6 feet in size.

The tanks accommodate aluminum sheets and extrusions up to 25 feet in length and are part of the equipment for preparing aluminum for porcelain enamel in the production of highway signs, and sheet steel for architectural trim purposes. A new continuous furnace has also been installed for use in fusing permanent color on signs up to 25 feet long and 5 feet wide.

The Jaybee Mfg. Co. of Los Angeles, producers of a wide variety of hardware products, recently completed installation of a 500 foot long conveyor system to facilitate operations in its plating department.

The conveyor was designed to the particular needs of the company and is reported not only to have speeded up production but reduced waste through lost units by nearly 25%. An overhead conveyor is installed next to the plating division, where the hardware pieces intended for plating come from the die cast section, and are racked on the overhead traveler. The system also includes four "free" conveyor lines in the loading area. This quartet of conveyors is geared to move toward a single powered track and are switched automatically on to the moving main conveyor line and on to the pre-cleaning area.

The subsequent pre-cleaning sequence takes the racked parts into the tanks, of which ten are available, including brass, bronze, chrome, copper, nickel, etc. From the tanks the parts are conveyed into and through the drying oven. The conveyor system is designed for complete control by one operator, who can stop, start, speed up, or slow down the carrier.

Less than three years ago all steel office furniture used in the Hawaiian Islands was manufactured on the mainland. Today steel desks, chairs, files and other office furniture is assembled, pre-finished, phosphated, and enameled in a plant in Oahu which is equipped to do everything in connection with the furniture except produce the steel itself.

The Sen Co., Inc., and Oahu Mfg. Co. began experimenting with steel furniture production three years ago. Orders then were taken on a bid work basis. Today the firm has its own shaping, welding, sanding, and buffing

ELECTROPLATED WIRE

CONTINUOUS PLATING ON SUB-MIL SIZES AND UP. HAVE YOUR WIRE PLATED OR BUY PLATED WIRE FROM US TO YOUR SPECIFICATIONS. A COMPLETE VARIETY OF PLATING MATERIALS AVAILABLE IN OUR ECONOMICAL SERVICE.

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ELECTRONOPLATE, INC.
Route 22 and Rock Ave.
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Color Buffing Compound 9993
By ARDCO

THE CRAFTSMAN'S CHOICE OF COLORING COMPOUNDS

ARDCO's New Coloring Compound 9993 enables you to reach a new level of excellence in clean, smooth, smudge-free, reflector bright surfaces when you color-buff non-ferrous metals. Products color buffed with 9993 bear the hallmark of true craftsmanship.

Write today for your free test application sample and for technical information on Compound 9993 and other ARDCO products.

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5000 W. 73rd Street Chicago 38, Illinois
Subsidiary of American Smelting and Refining Company

facilities, and recently brought its metal finishing section up-to-date with modern phosphating and enameling equipment.

Cold-rolled furniture steel is shipped to Oahu from the mainland in flat sheets. After shaping, notching and buffing, the steel passes through a 4-stage phosphating process. A prime coat is then applied in a spray booth, after which the furniture parts receive a coat of oven-baked enamel.

According to *Ralph B. Cherry*, manager of the Sen Co. the home-produced furniture saves local buyers about 25% on what they would have to pay for office furniture made on the mainland.

A large vat of nitric acid overflowed on October 17 in the plant of the Travis Plating Co., 12222 West Olympic Blvd., Los Angeles, causing evacuation of the building.

Fumes from the corrosive acid enveloped the neighborhood and made it necessary for police to divert traffic within several blocks of the shop. Fire department safety and salvage squads washed the floor of the plant down with hoses before the crew was permitted to re-enter. No injuries were reported.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Plans for Annual Convention Under Way

Herman A. Tessmann and others of his committee which includes *Ralph D. Wysong*, Asst. General Chairman, *Leonard Weeg*, Asst. General Chairman, *Joe Andrus*, Educational Chairman, *Robert Steuernagel*, Finance Chairman, and *Mrs. Charles Auchter*, Ladies Chairman, are completing plans for the annual convention to be held at the Schroeder Hotel in Milwaukee, Wis. on June 25-28, 1962.

This convention will differ from all previous ones in that it is sponsored by the Midwest Regional Council comprising the Chicago, Milwaukee, Mississippi Valley, Rockford, St. Joseph Valley, and St. Louis branches, instead

Herman A. Tessmann

of being under the sponsorship of one branch.

Preliminary plans call for the fourth William Blum Lecture, a three paper research session, a three paper color session, a three paper specifications session and other technical papers, and a possible round table discussion on the subject of "Cost Saving Items in the Plating Room."

A registration fee of $25 per person

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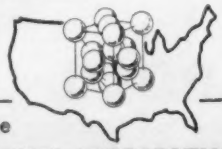
Reason . . . rugged construction features combined with 12 years experience in electro chemical applications. This means reduced downtime and dependable service under the most severe conditions.

Call or write for special Rectifier Requirements



12 years Design Experience

CONTINENTAL ELECTRONICS CORPORATION

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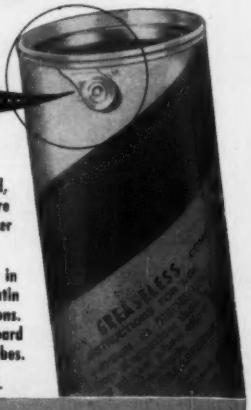
BISON *new improved* **GREASELESS COMPOUND**

in new lightning Aluminum tear opening top



* For Buffing, Burring, Polishing of Metals, Wood, Plastics.
* Bison New Improved, laboratory controlled, Greaseless Compounds work faster, are more economical, give uniform, cleaner, and higher quality finishes.
* Bison Greaseless compounds are available in any grit size required for butler, brushed, satin finishes and heavy-duty cutting operations. Are packaged in foil-lined tear top fibreboard containers as well as standard Aluminum tubes.

Write for samples. Jobbers inquiries invited.

BISON *Corporation*

1935 Allen Ave. S. E. Canton, Ohio

will include the banquet, an outing, and other convention events. A supervised children's sightseeing program will also be included, as well as a ladies' program, plant visitations, and a golf tournament.

For further information write Herman A. Tessmann, General Chairman, 1962 National A.E.S. Convention, 3864 S. 57th St., Milwaukee 20, Wis.

New York Branch

The Oct. 27 meeting was called to order by President *Jack Weiner* at 8:30 P.M., at the Statler. *Milton Nadel* informed the members that the Newark Branch will propose *Justus A. Stremel* for honorary member of National Society.

Librarian *Walter Schwartz* took over to conduct the educational session. He introduced *Norman I. Gaynes*, technical director of Titanine, Inc., who spoke on "Developments in Organic Finishes." Mr. Gaynes covered several of the coatings now in use, especially the epoxies.

Following the question and answer period, Mr. Gaynes received the thanks of the members for a good talk, after which the meeting was adjourned.

Fred Saras, Recording Secretary

Los Angeles Branch

A talk on "New Concepts in the Use of Coated Abrasive Belts" was presented as the educational feature of the October 11 meeting of the branch by *Frederick D. Stevens*, Los Angeles manager of industrial sales for the Behr-Manning Co. The presentation was in the form of informal discussion and answers to questions posed by the members and guests after a sound-color motion picture.

Election of branch delegates to the 1962 A.E.S. convention in Milwaukee, Wis., resulted in the following choices: Delegates, *Frank Eddy*, *John Millhorn*, and *Emmett H. Babcock*. Alternates, *Tony Stabile*, *Gene Weiner* and *Gene Bosl*.

Mr. Eddy, member of a national committee to study ways and means of streamlining Supreme Society operations to avoid financial drains, reported the study is well underway. Interchange of correspondence between him and other members of the committee, Eddy reported, indicates that definite progress is being made by the committee.

A decision was reached to start a drive to bring delinquent members back into the fold when the treasurer's report revealed that only 195 members had paid 1961-62 dues, with 160 still in arrears, as of October 11. President Emmett Babcock stressed the gravity of this situation by pointing out that the per capita tax must be forwarded to the national office by the end of October, and may result in financial loss to the branch if the tax is paid for members who ultimately fail to pay their dues.

Harvey K. Hunt, membership chairman, reported that the membership drive, which started a month ago and will continue through March, is producing good results through the inspiration of three substantial prizes: $50 for first place winner, $25 for second, and a year's dues for third.

John H. Jones, a research engineer with Autonetics, Inc., Compton, Calif., was initiated at the October meeting, and applicaitons were received from eight others.

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al session will be held at the Statler Hotel, Los Angeles in March or April. Definite date has not yet been agreed upon. *Barry Blackburn* has been named general chairman.

Detroit Branch

On Nov. 3, the branch held its monthly meeting at the Veteran's Memorial Building in the 8th floor dining room, overlooking the Detroit River. This was a special dinner meeting, organized by the branch officers, notably, *Ed Kubis, John Siefen* and *James "Doug" Thomas*, with the able assistance of other members of the executive group.

The meeting was well attended. The idea of the branch officers was to give the members a better understanding of the operation of their branch. National A.E.S. President *Chet Borlet*, and First Vice-President *Manuel Ben*, were present. The agenda included officers' informal reports, discussion of future plans of the branch, business aspects and open discussion from the floor. Dinner was preceeded by a cocktail hour.

William P. Devan, Publicity Chairman

Dayton Branch

The branch was honored at its Oct. 18 dinner meeting at the Seven Nations Restaurant by the presence of *Manuel Ben* and *Douglas Thomas*, who contributed to a spirited discussion of the proposed constitutional amendment regarding the Annual Proceedings. While the branch voted to retain the present arrangement, National Society Headquarters was severely criticized for the limited time allowed for returning an opinion on this important subject.

Delegates and alternates were elected as follows:

Delegates: *Byron A. Bowman, Robert L. Ruleff, Walter A. Anderson.*

Alternates: *John Easton, Lawrence N. Hadlock, Albert W. Wendt.*

Educational chairman *Paul Allison* introduced *Henry Strow*, of True Brite Chem. Prods. Co., Oakville, Conn., who discussed "Barrel-Nickel Plating." He traced the history of barrel nickel plating from the old double nickel salts bath to the present day bright nickel solution. His discussion covered common troubles from bath impurities through equipment deficiencies with recommended remedies.

The branch will be host for the Eighth Annual Tri-State Regional Technical Session and Dinner Dance at the Biltmore Hotel on March 3, 1962 with *Chester G. Borlet* as honorary chairman, and under the direction of *Walter W. Anderson*, general chairman.

The Educational Session will begin at 10 A.M. and, after a luncheon recess, will continue through the afternoon. The following speakers have been selected:

Ralph E. Pettit, Diversey Corporation: "Anodic Oxidation of Aluminum."

R. Scott Modjeska, Scientific Control Laboratories: "Deposition of Less Common Metals from Aqueous Solutions."

Dr. Eric Laue, MacDermid Corp.: "Contaminants in Cyanide Copper Solutions and Their Control."

J. C. Withers, American Machine & Foundry: "Electroplating Cermets."

Louis Gianelos, Harshaw Chemical Co.: "Metallographic Techniques."

The session will close with a dinner at 6:30 P.M. followed by dancing.

Baltimore-Washington Branch

The first meeting of the 1961-1962 season was held at the Brentwood Inn, Baltimore, Maryland. A large number of members and their guests enjoyed cocktails and a tour of the Inn's famous wine cellar of 20,000 bottles of rare wine prior to a delicious smorgasbord dinner. *Joseph Czernikowski*, member of The Wine Counselors Guild, addressed the group concerning the origin, manufacture, types and history of wine. *Dr. R. Scott Modjeska*, of the Chicago Branch, was present as a guest.

Henry A. Pierdon was elected to membership. Witnessing his election were his father, *Arthur G. Pierdon*, and grandfather, *Fred F. Pierdon*, one of the charter members of the AES.

The membership discussed the question of the Technical Proceedings being eliminated as a requirement of the National Society. During the discussion, strong emphasis was placed on the continuing deficit spending of the National Society. It was suggested that the National Executive Board should devote every effort to find ways and means to equalize income and expenditures.

Kenneth M. Huston, Past National President, presented a Branch Past President's pin to immediate Past President *Harold W. Scott.*

Featured speaker of the evening was *Alfred M. Weisberg*, vice-president, Technic, Inc. Mr. Weisberg's subject was "Methods and Applications of Precious Metal Electroplating." Prior to beginning his featured presentation, Mr. Weisberg addressed his remarks to the ladies present concerning the antiquity of the art of plating.

Harold W. Scott, Secy.-Treas.

Chicago Branch

The branch held the monthly meeting on Friday, Oct. 13, at the Chem-

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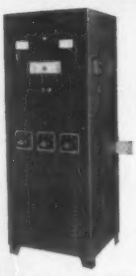

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istry Building of Armour Research Foundation, 35th and Dearborn Sts. Three applications for membership were turned over to the board of managers and one application was approved. Mr. Glab read a letter regarding the start of a new branch of the A.E.S. at Cedar Rapids, Iowa, with the first meeting to be held on Thursday, November 16, 1961, at the Hotel Roosevelt. The committees for the banquet and "Ladies-Nite" will have a preliminary report for the next meeting. *Si Gary* reported that the new roster for the branch including the sustaining members will be ready for printing in the near future. An award of $25.00 will be given for the best article on "Cost Saving Ideas in the Plating Room." All members were urged to send in their ideas and win the award. The winning article will also appear in the proceedings of the National Convention in 1962.

The October meeting marked the beginning of a series of short technical presentations, of 10 minute duration, on shop operations, processing, solving of a problem, etc., prior to the regular technical program. *Ben Rudenga* and *Steve Putek*, of Bell and Howell, discussed "Automatic Polishing of Aluminum Die Castings to Close Tolerances." *Art Bartmann* handled the question and answer period for this presentation.

The guest speaker for the evening was *John A. Hendricks*, of Alcor Chem. Co., who spoke on the "Mechanisms in Bright Plating." After a question and answer period he was given a rising vote of thanks for his interesting and informative talk.

Christopher Marzano, Pub. Chair.

Buffalo Branch

The branch held its October 13 meeting at the Peacock Inn in Mayville, N. Y. with 30 members and guests in attendance. Guests of the evening introduced by President *John Donaldson* were *Jack Henderson, Larry Felton, Paul Westman, Harry Carlson, Lyle Petersen,* and *A. C. Hart.*

James Dickens and *Michael Guerico* were elected to membership. *Dick Davis* reported on membership changes from the end of the 1960-61 season to Oct. 1, 1961. *Chuck Fotheringham* reported on the annual Christmas Party to be held Saturday, Dec. 9, at the Red Lobster.

After the business session, Educational Chairman *George Wolf* introduced *Walter Pocock*, development engineer, Allied Research Products, Inc., who spoke on "Water Soluble Resin Systems."

The annual Christmas Party will be held in place of the regular business and technical meeting in December.

The January meeting will be held Friday, Jan. 5, 1962; details to be announced later.

Robert E. Lienert, Secretary

St. Louis Branch

The first Fall meeting was held Oct. 11 at the Elk's Club, 3617 Lindell Blvd. There were 32 members and guests present for dinner and 37 present when President *Homer Thomen* called the business meeting to order.

The 25-year certificate was exhibited, and a motion was made that the branch buy the certificates and have a presentation night and buy the dinner for the members receiving certificates. The motion passed with one dissenting vote. A discussion followed, concerning the dinner meeting place. A motion was made that a committee be appointed to locate a meeting place. The chairman named the following: *Ward Kelly, William Piel, John Moran.*

Andy Julius reported as delegate to the National Convention. A per-capita tax increase was asked for, finally agreed on plan to vote on discontinuing the publishing of Technical Proceedings, which requires a by-laws change. Delegates were to explain this approximate $2.50 per member saving and then a letter ballot would be sent to each branch.

The meeting was turned over to *Charles Hamm*, educational chairman, who introduced *Howard J. McAleer*, president of Formax Mfg. Corp. Mr. McAleer is Chairman of the 1964 St. Louis Exposition. He talked on polishing and buffing. An interesting question and answer period followed his enlightening talk. Members gave Mr. McAleer a rising vote of thanks and the meeting was adjourned 10:00 P.M.

Ward Kelly, Secretary

Pittsburgh Branch

The October meeting was held at the Gateway Plaza on Wednesday, Oct. 11. After dinner, President *Chuck Forbes* asked for a roll call of officers to open the business meeting. Everyone was then asked to stand and state their name and company affiliation.

Myron Ceresa reported, as a delegate, on the proposal of having the Convention Proceedings sold by subscription instead of being distributed to each member as is now being done. Some discussion followed and a vote was asked for by Mr. Forbes. The majority of those present were in favor of leaving the Constitution as is.

One new member was welcomed into the group, *Gerald Slade*, of Wear Well Plating Co. Before introducing the speaker, Educational Chairman *Walter Johnson* announced that the panel discussion to be held at the November meeting was open to receive questions. The panel will consist of several "experts" from the branch. Mr. Johnson then introduced *P. J. Verlinich*, of

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Schaffner Mfg. Co., whose subject was "Buffing and Grinding." After his talk Mr. Verlinich answered a number of questions from the floor and received a rising vote of thanks from the group.

Fred Stevens, Publicity Chairman

Newark Branch

President *Al Korbelak* called the October meeting to order with about 75 members and guests in attendance at the Robert Treat Hotel. No new applications were received. *Ed Bertuccio* transferred into the branch. The following were elected to membership: *R. Weil*, Stevens Institute of Technology; *F. J. Frey* and *F. T. Gallico*, Art Metal, Inc.; *D. C. Johnson*, Sel-Rex Corp.; *N. A. Ciccone*, Electrical Industries; and *F. P. Travisano*, Acme Plating Works.

Treasurer *George Wagner* reported that the branch was in a sound financial position. The proposal to delete "Proceedings" as a service to the membership was brought before the members. After much discussion, it was decided that the delegates be instructed to vote against the proposal as suggested by the National Society. Following this, *R. A. Ehrhardt* was asked to present and install the delegates and alternate delegates who were elected last March.

The branch announced that the winner of the *Louis Donroe Award* for last year is *George R. Shaw*. "Old Timers Night" was celebrated by inviting them to dinner. In addition, a plaque was presented to all branch members with 25 years or more of service. President Korbelak presented plaques to the following old timers who were present: Messrs. *D. Davies, W. F. Hodecker, P. Oldam, G. Reuter, P. Santella, S. Taylor, E. R. Van Der Hoef, G. Wagner*, and *Dr. W. A. Wesley. Don Volino* accepted for *G. Klinkenstein*, who was unable to attend. Messrs. Reuter, Taylor and Dr. Wesley then spoke a few minutes on the merits of being a branch member.

Librarian *Gene Wagner* then introduced *G. Martusevich*, whose timely topic was "Polarization and Passivity." He then presented *Dr. Walter Meyer*, who spoke on "Hazards in the Plating Room."

Both speakers were given a rising vote of thanks and the group retired to partake of a light refreshment.

Gustav Bittrich, Asst. Secretary

New York Branch

President *Jack Weiner* called the Oct. 13 meeting to order at the Statler at 8:30 P.M. He then introduced *Dr. Hiroshi Asada* of the Aeronautical Research Institute of the University of Tokyo, and secretary, Metal Finishing Society of Japan, here to attend the Annual Convention of The Magnesium Association.

Milton Nadel informed the members of the passing away of Messrs. *James Acierno, Sam Goldstein* and *Herbert Millwater*. A minute of silence was observed in memory of departed members. A motion was made and carried that application for membership from *Stanley J. Bielaczy* follow regular course, and to accept *Lawrence Eccles* as a member. The following members were elected as delegates to the A.E.S. Convention to be held at Milwaukee.

Delegates: *Jack Weiner, Milton Nadel, Isidore Friedman.*

Alternates: *Angelo Amatore, Joseph Rembecki, George Herrmann.*

A motion made and carried instructing delegates to vote no to the proposed amendment to National By-Laws discontinuing printing and mailing of

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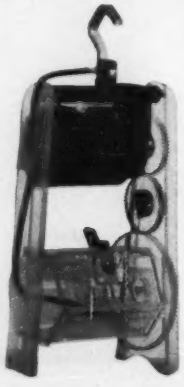

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Technical Proceedings to all members. The delegates to the Boston Convention received a rising vote of thanks for a job well done. Chairman *Sol Adder* and members of the By-Laws Committee received a rising vote of thanks for their labors on the new branch by-laws.

Librarian *Walter Schwartz* took over to conduct a session on "Shop Problems And Answers to These Problems." All problems brought to the floor received answers from members who had similar experiences before. Walter promised to provide a large Question Box where members can put their large or small problems and the experts will give the answers.

Fred Saras, Recording Secretary

Midwest Regional Council

The Third Annual Technical Seminar sponsored by the Midwest Regional Council of the A.E.S., held at Argonne National Laboratories on Saturday Oct. 28th, was not only a well attended conference with 241 members and guests but one of the outstanding scientific sessions ever sponsored by the society. It featured eight important papers on the plating of the various exotic metals now coming into common production through the needs of the space age.

A more fitting site could not have been chosen by the general co-chairmen, *Dr. Jay H. Monoweck* and *Clyde Kelly*, than this great institution of scientific research whose many projects include such items as the development of metal finishing processes and techniques as related to nuclear energy. All who so desired were escorted on short, guided field trips through three of the buildings of this AEC reesarch institution which is operated under contract by the University of Chicago.

The first paper of the Symposium was "Plating On Uranium" by *Dr. Jay H. Monweck*, of Argonne Lab. During the morning session, the Symposium continued with a paper by *Dr. C. Dubpernell*, of Metal and Thermit, on "Electroplating Chromium And Its Alloys," which was immediately followed by *Christopher Marzano*, of Amphenol-Borg Electronics Co., who spoke on "Plating On Tungsten" and the final paper of the morning was given by *Dr. D. Gardner Foulke* of Sel-Rex, who spoke on "Plating On Precious Metals."

While these papers were being given, *Tom McCullough*, of National Lock Co., moderated the Organic Finishing Workshop in another area, with the able help of a panel which included *Joe Andrus*, Croname Inc., *Peter Iwema*, duPont Finishes Div., *James F. Wright*, Wright Metal Processors, and *Frank Foreman* of Barber Coleman Co.

Simultaneously, in another conference hall, *Sy Gary*, of Scientific Control Laboratories, moderated a very interesting and well attended workshop on pickling and bright dipping with an excellent panel of experts made up of *Jack Eley*, duPont, *William Innes*, MacDermid, Inc., *John Jumer*, Alchemize Corp., *Ken Westerberg*, Mechanical Plating Co., and *Robert Schub*, London Chem., Inc.

Following an exceptionally superb strip steak luncheon in the laboratory cafeteria, the meetings reconvened at 1:45. In the main auditorium *Chris Marzano* presented a second paper on "Deposition Of Uranium From Molten Salts," while workshops on barrel pla-

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ting and cleaning reconvened in the smaller chambers.

The symposium continued with a paper "Plating On Titanium" by *W. B. Harding*, of Bendix Corp., which was followed by the representative from another atomic laboratory at Los Alamos. *James Gore* gave a third paper on "Plating On Uranium," offering some very practical procedures, and the session concluded with an exceptionally interesting paper, "Plating Various Metals On Silicons," by *Dr. Geo. Wertwejn.*

Educational Chairman *Dr. R. Scott Modjeska* announced that all papers given, together with a selected group of related papers given under different circumstances in this related area of investigation, will be augmented and prepared for the Publications Committee of the A.E.S. to enrich the literature of the industry.

Meanwhile the workshop on barrel plating, ably moderated by *E. P. Mc Coy*, Electrochemical Products Co., gave the panel consisting of *Joe Corre*, Amphenol-Borg Electronics Co., *Dr. Russel Harr*, Western Electric Co., *William Geissman*, National Lock Co., and *Herman Tessmann*, Allen Bradley Co., a truly active session.

In Room 183 a standing room only crowd gave the workshop on cleaning a hard time and groped for many answers to difficult cleaning problems. While *Dr. Russel Harr* was listed on the program as moderator of this panel, he was appearing at the same time as a panel member in the barrel plating workshop. The cleaning panel was therefore moderated very capably by *Dr. Ed. Saubestre*, of Enthone, Inc., who kept things moving for *Bob Lewis*, of Northwest Chem. Co., *Bob Bender*, of Oakite, *Bob Goodsell*, Enthone, *Ed Stack*, MacDermid, and *Clarence Kolzow*, Western Electric Co. This workshop became so actively interesting that it ran well over the allotted time and had to be adjourned so that the subsequent meeting of the Midwest Regional Council could take place.

At 4:45 *Les Dively*, council chairman, called the regional council to order and introduced the National President, *Chet Borlet*, who, after commenting upon the importance of the day's seminar as a true example of the purpose of the Society in a free interexchange of technical data, went on to explain the nature and purpose of the proposed paper ballot voting with reference to constitutional change. A pool of the delegates present indicated that a majority of the branches which comprise the regional council are in favor of this constitutional change.

The site for the Fourth Annual Technical Seminar has been selected as Washington University, St. Louis, Mo., at the end of October 1962. This meeting will be under the general chairmanship of *Andy Julius* of the St. Louis Branch.

Alexander Alexander

A.S.T.M.

Committee B-8 has announced an event of unusual interest which will occur at the Statler Hilton Hotel in Dallas, Texas, on February 6 and 7, 1962. Coinciding with A.S.T.M. Committee Week, there will be a two-day symposium entitled "Electroforming—Its Applications, Uses and Properties of Electroformed Metals."

Electroforming, the science of creating or reproducing objects by electrodeposition, is a growing industry. While several technical articles have been written on the subject, this will be the first time that a comprehensive coverage of the industry will be made by recognized authorities in the electroforming field. The two-day session will include papers and discussions on the solutions used, the techniques employed and the applications of the science to the creation or reproduction of objects in the various fields as listed in the program.

A. D. Squitero and *W. L. Pinner* are co-chairmen of the symposium.

AMERICAN ZINC INSTITUTE

Ernest W. Horvick has just been named director of technical services for the Institute. A member of the market development staff for the past nine years, he will have a primary responsibility for the technical aspects of the Institute's services, in relation to market development and sales promotion.

Ernest H. Horvick

Before joining the Institute, Horvick was on the staffs of Weirton Steel Co., Bell Aircraft, and Minneapolis Honeywell in technical, supervisory, and marketing capacities. He is a graduate of Princton University, where he was awarded a chemical engineering degree in 1935. He is a member of the American Chemical Society, the American Society for Metals, and the Society of Die Casting Engineers.

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18"	18"	18"	53"	39"	34"
20"	14"	36"	56"	44"	39"
24"	12"	12"	58"	22"	30"
24"	12"	24"	59"	42"	36"
24"	24"	36"	60"	18"	18"
26"	21"	23"	60"	21"	37"
27"	12"	37"	60"	36"	24"
28"	19"	23"	72"	18"	18"
29"	21"	24"	72"	23"	30"
30"	24"	30"	72"	35"	20"
30"	30"	30"	72"	42"	36"
30"	30"	36"	72"	48"	30"
31"	17"	17"	72"	48"	36"
36"	32"	42"	72"	60"	60"
36"	36"	42"	84"	12"	24"
38"	36"	30"	84"	20"	24"
40"	36"	36"	84"	25"	30"
42"	30"	48"	120"	36"	36"
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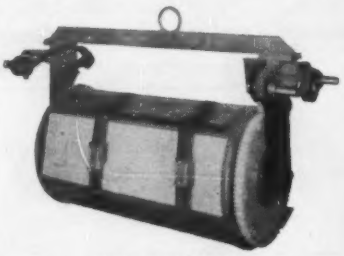

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698	47.5	Elec. Prod.
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940	32	Elec. Prod.
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1000/500	12/24	H-V-W
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1500	30/50	Century
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INDEX TO VOLUME 59 — METAL FINISHING

JANUARY-DECEMBER, 1961

(Compiled by N. Hall, Technical Editor, and I. Oquendo, Equipment and News Editor)

In this index all material that appeared in the January through December 1961 issues of *Metal Finishing* is listed according to subject matter, with cross references where required. Following each listing will be found a letter indicating the manner in which the material was published, as follows:

(S)—Shop Problem
(R)—Recent Development
(P)—Patent
(M)—Manufacturers' Literature
(B)—Book
(A)—Abstract from Foreign Literature

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Jan. 20: Annual Meeting, Grand Rapids Branch AES, Pantlind Hotel, Grand Rapids, Mich.

Jan. 27: Annual Educational Meeting and Banquet, Chicago Branch AES, Conrad Hilton Hotel, Chicago, Ill.

Jan. 30-Feb. 2: 18th Annual Technical Conference, Society of Plastics Engineers, Penn-Sheraton Hotel, Pittsburgh, Pa.

Feb. 6-7: Two-Day Symposium, ASTM, Statler-Hilton Hotel, Dallas, Texas.

Feb. 9-10: 4th Annual Educational Session, Dixie Regional AES, Dinkler-Plaza Hotel, Atlanta, Ga.

Feb. 17: Annual Technical Session and Banquet, New York Branch AES, Hotel Statler-Hilton, New York, N. Y.

Mar. 2-3: Annual Educational Session and Banquet, Philadelphia Branch AES, Benjamin Franklin Hotel, Philadelphia, Pa.

Mar. 6-7: 5th Annual Technical Conference, Society of Vacuum Coaters, Sheraton-Cleveland Hotel, Cleveland, Ohio.

Mar. 19-23: 18th Annual Conference and Corrosion Show, National Association of Corrosion Engineers, Kansas City Auditorium, Kansas City, Mo.

Oct. 29-Nov. 2: World Metal Show and National Metal Congress, American Society for Metals, Coliseum, New York, N. Y.

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81 Industrial Rd., Berkeley Heights, N. J.

Koch Sons, Inc., George
10 S. 11th Ave., Evansville 4, Ind.

Kocour Co.
4800 So. St. Louis Ave., Chicago 32, Ill.

Kosmos Electro-Finishing Research, Inc.
140 Liberty St., Hackensack, N. J.

Kushner, Dr. Joseph B. 108
621 S. Norman, Evansville 14, Ind.

Lasalco, Inc. 19
2820-38 LaSalle St., St. Louis 4, Mo.

Lea Mfg. Co. 75
16 Cherry Ave., Waterbury 20, Conn.

Lea-Michigan, Inc. 103
14459 Wildemere Ave., Detroit 38, Mich.

Lea Products Co. 22
996 De Boullion St., Montreal 15, Quebec, Can.

Lea-Ronal, Inc. 76
130-19 180th St., Jamaica 34, N. Y.

L'Hommedieu & Sons Co., Chas. F.
4521 Ogden Ave., Chicago 23, Ill.

Lindale Equipment & Supply Corp. 109
504 Smith St., Brooklyn 31, N. Y.

Macarr, Inc.
4360 Bullard Ave., Bronx 66, N. Y.

MacDermid Inc. Back Cover
Waterbury 20, Conn.

Magnus Chemical Co., Inc.
11 South Ave., Garwood, N. J.

Manhattan Rubber Div., Raybestos-Manhattan, Inc.
6 Willett St., Passaic, N. J.

Meaker Co., The
Sub. of Sel-Rex Corp., Nutley 10, N. J.

Metal & Thermit Corp. 42
Rahway, N. J.

Michigan Buff Co., Inc. 111
3503 Gaylord Ave., Detroit 12, Mich.

Mitchell-Bradford Chemical Co.
Wampus Lane, Milford, Conn.

Motor Repair & Mfg. Co., The 110
1555 Hamilton Ave., Cleveland 14, Ohio

Murray Way Corp. 95
P. O. Box 180, Maple Rd. E., Birmingham, Mich.

Nankervis Co., Geo. L.
16000 Fullerton, Detroit 27, Mich.

National Plastics & Plating Supply Co.
Box 34, Terryville, Conn.

New England Coating Works, Inc. 100
349 Bryant Ave., New York 59, N. Y.

New Holland Machine Co. 103
New Holland, Pa.

N. J. Thermex Co., Inc. 93
535 Bergen St., Harrison, N. J.

Northwest Chemical Co. 27
9310 Roselawn Ave., Detroit 4, Mich.

Nu-Lite Plating Equipment Co., Inc. 107
777 Meaker Ave., Brooklyn 22, N. Y.

Nuodex Products Div., Heyden Newport Chemical Corp. 23
Box 242, Elizabeth, N. J.

Oakite Products, Inc.
118 Rector St., New York 6, N. Y.

Packer Machine Co.
456 Center St., Meriden, Conn.

Park Equipment & Supply Corp. 109
604 - 20th St., Brooklyn 18, N. Y.

Pesco Plating Equipment Corp.
75 Wythe Ave., Brooklyn 11, N. Y.

Pfizer & Co., Inc., Chas. 16
235 E. 42nd St., New York 17, N. Y.

Phelps Dodge Refining Corp.
300 Park Ave., New York 22, N. Y.

Phillips Manufacturing Co. 89
3475 Touhy Ave., Chicago 45, Ill.

Pittsburgh Plate Glass Co., Paint Div.
One Gateway Center, Pittsburgh 22, Pa.

Plating Products, Inc. 105
1509 N. Washington, Kokomo, Ind.

Puma Corp. 13
P. O. Box 82, Farmingdale, L. I., N. Y.

Ramco Equipment Corp.
801 Edgewater Rd., New York 59, N. Y.

Randolph Products Co.
92 N. 12th St., Carlstadt, N. J.

Ransburg Electro-Coating Corp.
3939 W. 56th St., Indianapolis 23, Ind.

Rapid Electric Co., Inc. Inside Front Cover
2881 Middletown Rd., Bronx 61, N. Y.

Raybestos-Manhattan, Inc. Manhattan Rubber Div.
Passaic, N. J.

Reliable Industrial Equipment Co., Inc. 110
633 Richmond St. N.W., Grand Rapids 4, Mich.

Rona Pearl Corp., Div. Rona Laboratories, Inc. 98
E. 21st & E. 22nd Sts., Bayonne 3, N. J.

Schaffner Mfg. Co., Inc.
Schaffner Center, Emsworth, Pittsburgh 2, Pa.

Seaway Nickel Div., Roblin-Seaway Industries, Inc. 40
No. Tonawanda, N. Y.

Sel-Rex Corp. Inside Back Cover
75 River Rd., Nutley 10, N. J.

Service Research and Development Co., Inc. 100
Rt. 22 and Greeley Ave., Union, N. J.

Sethco Mfg. Corp. 80, 81
2286 Babylon Turnpike, Merrick, L. I., N. Y.

Singleton Co., The 20
11720 Berea Rd., Cleveland 11, Ohio

Sommers Bros. Mfg. Co. 108
3439 No. Broadway, St. Louis 7, Mo.

Stevens, Inc., Frederic B. 15
1808 - 18th St., Detroit 16, Mich.

Stutz Co., The 26
4430 Carroll Ave., Chicago 24, Ill.

Technic, Inc. 41
88 Spectacle St., Cranston, R. I.

Titanium Products Corp. 104
9301 French Rd., Detroit 13, Mich.

True Brite Chemical Products Co. 99
P. O. Box 31, Oakville, Conn.

Udylite Corp., The 35-38
Detroit 11, Mich

Unit Process Assemblies, Inc. 34
53-15 37th Ave., Woodside 77, N. Y.

Unitron Instrument Co., Microscope Sales Div. 96
66 Needham St., Newton Highlands 61, Mass.

Universal Vibrating Screen Co.
1745 Deane Blvd., Racine, Wis.

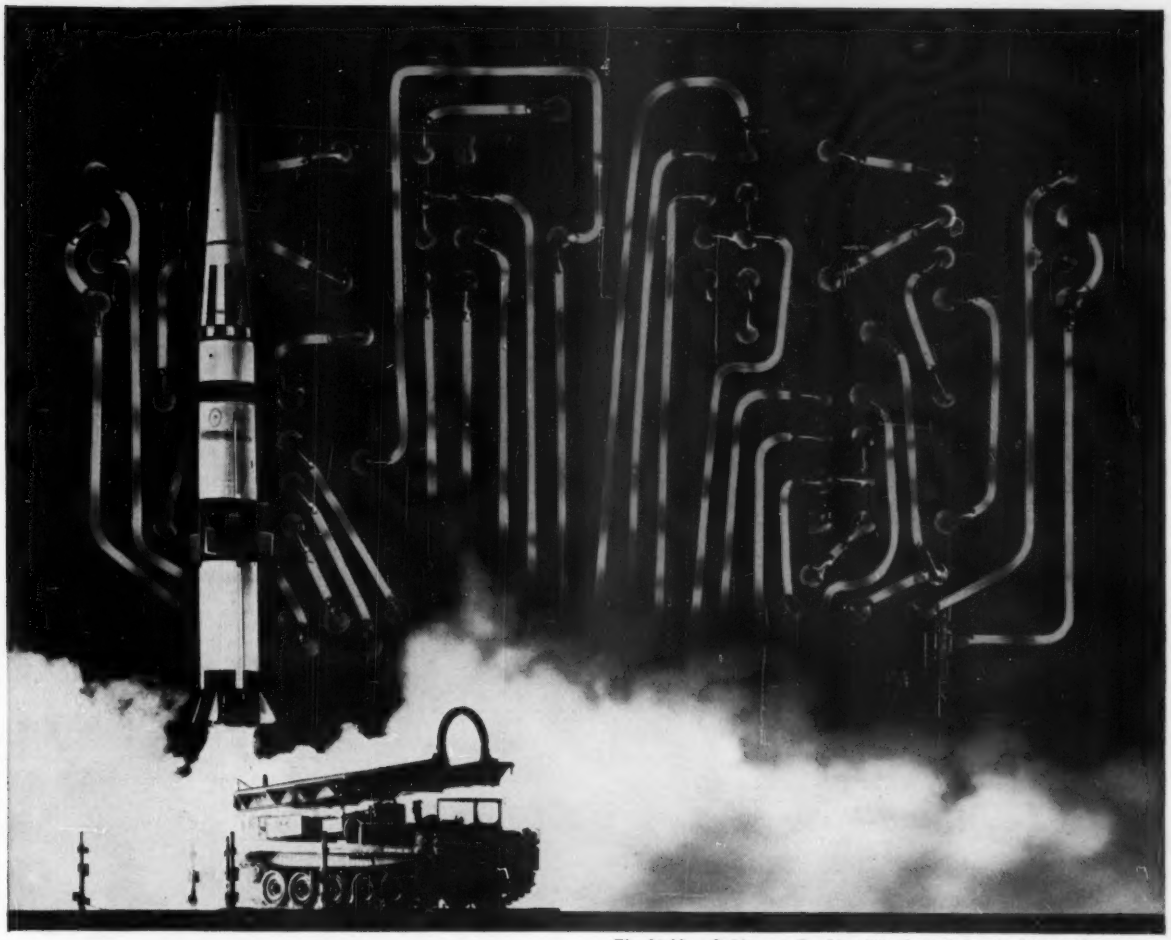
Univertical Corp. 92
14841 Meyers Rd., Detroit 27, Mich.

Vic Manufacturing Co.
1313 Hawthorne Ave., Minneapolis, Minn.

Worthy Products Co. 110
Box 1432, Boca Raton, Fla.

Wyandotte Chemicals Corp.
Wyandotte, Mich.

Zialite Corp.
92 Grove St., Worcester 5, Mass.



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